Lost and Found *in Mathematics*

Dissident cosmologists's guide to the Universe

This book is inspired by a German theoretical physicist, Sabine Hossenfelder's publication: "*Lost in Mathematics*". Her book seems to question highly mathematical and a lot of abstraction in the development of physics and cosmology studies nowadays.

There is clear tendency that in recent decades, the physics science has been predominated by such an advanced mathematics, which at times sounding more like acrobatics approach to a reality.

Through books by senior mathematical-physicists like Unzicker and Peter Woit, we know that the answer of TOE is not in superstring theories or other variations of such 26 dimensional bosonic string theory, of which none of those theories survived experimental test, but perhaps in low dimensional physics. As Alexander Unzicker suggests, perhaps it is more advisable to consider rotation in 3D space (known as SO3), or a kind of superfluid vortices version of gravitation theory.

Then you may understand how beautiful is God design, beyond what we as mere mortals can understand with our math and logic prowess.

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Victor Christianto

&

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Neutrosophic Science International Association (NSIA)
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Dedication

This book is dedicated to all of you, real truth-seekers all over the world, especially those who are persecuted for the sake of finding the real Truth through mutual dialogue between science, theology, and spirituality from various (ancient) traditions.

This is message for you:

Blessed are the merciful,
For they shall obtain mercy.
Blessed are the pure in heart,
For they shall see God.
Blessed are the peacemakers,
For they shall be called sons of God.
Blessed are those who are persecuted for righteousness' sake,
For theirs is the kingdom of heaven.

(Gospel of Matthew chapter 5, NKJV version).[1]

1 https://biblehub.com/nkjv/matthew/5.htm

Preface

This book is inspired by a German theoretical physicist, Sabine Hossenfelder's publication: "*Lost in Mathematics*". Her book seems to question highly mathematical and a lot of abstraction in the development of physics and cosmology studies nowadays.

There is clear tendency that in recent decades, the physics science has been predominated by such an advanced mathematics, which at times sounding more like acrobatics approach to a reality.

Through books by senior mathematical-physicists like Unzicker and Peter Woit, we know that the answer of TOE is not in superstring theories or other variations of such 26 dimensional bosonic string theory, of which none of those theories survived experimental test, but perhaps in low dimensional physics. As Alexander Unzicker suggests, perhaps it is more advisable to consider rotation in 3D space (known as SO3), or a kind of superfluid vortices version of gravitation theory.

We can also reconsider proposition by the late Prof F. Winterberg (formerly professor at Univ. Nevada, Reno), that it is most likely that superfluid phonon roton theory in 3D can replace the entire superstring theories.

While we don't explore yet implications of his model to particle physics, we discuss here some published papers at several journals in the past few years.

Interested readers can find Winterberg's book, with title something like: "*Finititude theory of physics*". In the first section, you will find: (i) One-Note-Samba Approach to Cosmology, (ii) Towards Gross-Pitaevskiian Description of Solar System & Galaxies, (iii) A Data-driven Approach to Astrophysics:

Towards Quantum Geophysics and Quantum Astrophysics, (iv) Dialogue between two Chief Worldview Systems on Quantized Orbit Distances as Astrophysics Phenomena.

In the second section, you can read: (i) How to Balance Intuitive and Analytical Functions of Brain: A Neutrosophic Way of Scientific Discovery Process, (ii) Eureka Moment as Divine Spark; (iii) A Harmless Wireless Quantum Alternative to Cell Phones Based on Quantum Noise; (iv) An Outline of New Proof of the Existence of God.

You may find sometime to read and digest what we wrote in chapters in this book, but in order to find the real truth of nature, our suggestion is that you shall begin to use your right hemisphere of your brain, which suggests : *use your holistic, spirituality approach, not only logical approach*.

Then you may understand how beautiful is God design, beyond what we as mere mortals can understand with our math and logic prowess.

Sometimes, we shall admit that there are findings that "*mathematics is not yet ready for such things*."[2]

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2 https://quotefancy.com/quote/1178139/Paul-Erd-s-Mathematics-is-not-yet-ready-for-such-problems

Content

A

4 papers on a Consistent Model Gravitation from Solar System to Galaxy Scale

One-Note-Samba Approach to Cosmology

Victor Christianto[1*] & Florentin Smarandache[2]

[1]Satyabhakti Advanced School of Theology,
Jakarta, Indonesia

[2]Dept. of Math. Sci., Univ. of New Mexico, Gallup, USA

* Correspondence:
Victor Christianto, Independent Researcher.
Email: victorchristianto@gmail.com

Abstract

Inspired by One Note Samba, a standard jazz repertoire, we present an outline of Bose-Einstein Condensate Cosmology. Although this approach seems awkward and a bit off the wall at first glance, it is not impossible to

connect altogether BEC, Scalar Field Cosmology and Feshbach Resonance with Ermakov-Pinney equation. We also briefly discuss possible link with our previous paper which describes Newtonian Universe with Vortex in terms of Ermakov equation.

Keywords: Cosmology, Bose-Einstein condensate, scalar field, Feshbach resonance, Ermakov-Pinney equation, Newtonian universe, vortex.

Introduction

From time to time, it is often found useful to come up with a new approach in cosmology studies, in order to seek a new insight from where we can develop and take further step.

For instance, it is known that flat spacetime cosmology can explain many cosmology phenomena (see for instance Narlikar & Arp [30]). But then, if we know that there is quite high likelihood that our Universe can be modeled as flat spacetime, then what else to be done?

In this occasion, allow us to put forth an argument that our Universe has remarkable similarity with a macroscale Bose-Einstein condensate, especially on the grounds: a. the CMBR temperature is found to be as low as 2.73^0 Kelvin, therefore it may indicate a low temperature physics model of Universe (see G. Volovik [31]), and b. recent discovery of "black hole" seems remarkably similar to a vortex ring of BEC experiment (it shows a dark spot circled with a white ring).

All in all, although we admit that this approach seems awkward and a bit off the wall at first glance, it is not impossible to connect altogether BEC, Scalar Field Cosmology and Feshbach Resonance with Ermakov-Pinney equation. We also discuss shortly possible link with our previous paper, where we describe Newtonian Universe with Vortex in terms of Ermakov equation [5].

We submit to call this approach: "*one note Samba*", i.e. starting with a very simple premise (BEC) you arrive at a model of the entire Universe.

Lidsey's BEC-Cosmodynamics Correspondence

According to Hawkins & Lidsey [2], the dynamics of cosmologies sourced by a mixture of perfect fluids and self–interacting scalar fields are described by the non–linear, Ermakov–Pinney equation. The general solution of this equation can be expressed in terms of particular solutions to a related, linear differential equation. In general, an Ermakov system is a pair of coupled, second–order, non–linear ordinary differential equations (ODEs) and such systems often arise in studies of nonlinear optics [12], nonlinear elasticity, molecular structures.

They developed an analytical approach to models of this type by expressing the cosmological field equations in terms of an Ermakov system. In the one–dimensional case, the two equations decouple and the system reduces to a single equation known as the Ermakov–Pinney equation [2]: 2 3

$$\frac{d^2b}{d\tau^2} + Q(\tau)b = \frac{\lambda}{b^3} \tag{1}$$

where Q is an arbitrary function of τ and λ is a constant. Equation (1) is sometimes referred to as the Milne–Pinney equation. They also showed that the field equations for a spatially flat, Friedmann–Robertson–Walker (FRW) universe with a scalar field and perfect fluid matter source reduce to Ermakov-Pinney equation. To summarize, the dynamics of a pure scalar field cosmology is determined by a one–dimensional oscillator equation with a time–dependent frequency. [2] In his subsequent paper, Lidsey managed to show that there is dynamical correspondence between positively curved, isotropic, perfect fluid cosmologies and quasi-two-dimensional, harmonically trapped Bose-Einstein condensates by mapping the equations of motion for both systems onto the one-dimensional Ermakov system.[1]

He developed that connection based *on analogies between various condensed matter systems and different branches of gravitational physics* which

have been developed in recent years. For example, the propagation of acoustic waves in an irrotational, inviscid, barotropic fluid is formally equivalent to that of a massless scalar field on a curved, Lorentzian spacetime. Furthermore, it is possible to model a black hole acoustically in terms of supersonic fluid flow and, in principle, quantum effects associated with black hole event horizons may then be studied within the context of condensed matter configurations.[1]

Identifying such a link is quite significant because if it can be shown that there exists dynamical correspondence between isotropic, four–dimensional cosmological models and harmonically trapped, quasi–two–dimensional Bose–Einstein condensates, then there is a big hope to do simulation or cosmology experiments in lab. The correspondence arises because the equations of motion for both systems can be mapped onto the one–dimensional Ermakov system.

In that paper, Lidsey showed that the dynamics of a positively curved ($k > 0$) FRW cosmology can be modeled in terms of a harmonically trapped Bose–Einstein condensate when cosmic time, τ is related to 'laboratory' time, t.[1]

To summarize our discussion thus far, it can be shown that positively curved, perfect fluid FRW cosmologies can be modeled dynamically in terms of quasi–two–dimensional Bose–Einstein condensates, where there exists a one–to–one correspondence between the type of matter in the universe and the functional form of the time–dependent trapping potential of the condensate. The physical properties of the wavefunction can be identified with the fundamental cosmological parameters.[1]

The Pinney equation corresponding to FRW cosmology can be written as follows [1]:

$$\frac{d^2a}{dt^2} + \left(\frac{d\phi}{dt}\right)^2 a = \frac{k}{a^3} \tag{2}$$

A key assumption that was made in establishing the correspondence between the condensate and cosmological systems was that the dynamics of the condensate wavefunction can be described in terms of the Gross–Pitaevskii equation at each moment of time, i.e., that the configuration reacts instantaneously to changes in the trapping potential and scattering length of the atomic interactions. If this assumption is to remain valid, the majority of the atoms must remain in the condensate state (mean–field approximation) and the particle density and scattering length must be sufficiently small (dilute gas approximation) [1].

Nevertheless, one advantage of establishing correspondences between cosmology and condensed matter physics through Ermakov systems is that insight into the hidden symmetries of the two systems may be uncovered.

Subsequent work by Herring et al. revisit the topic of two-dimensional Bose-Einstein condensates under the influence of time-dependent magnetic confinement and time-dependent scattering length. A moment approach reduces the examination of moments of the wavefunction (in particular, of its width) to an Ermakov-Pinney (EP) ordinary differential equation (ODE). They discussed Feshbach resonance managed BEC and how EP equation connects with the case of anisotropic scalar field cosmologies [3].

There is also a more recent report by D'Ambroise and Williams showing that there is also dynamic correspondence not only to FLRW but also Bianchi I cosmologies and BEC system in arbitrary dimension, especially when a cosmological constant is present [4].

Comparison with Newtonian Dynamics Model

In a previous paper [5], we presented a numerical solution of Newtonian Universe with vortex; see also [6][7]. Now we will present a more detailed account of our model.

A physical model of turbulence-generated sound for early Universe

Our discussion starts from the fundamental question: how can we include the rotation in early Universe model? After answering that question, we will discuss how "turbulence-generated sound" can be put into a mathematical model for the early Universe. We are aware that the notion of turbulence-generated sound is not new term at all especially in aerodynamics, but the term is rarely used in cosmology until now. We shall show that 3D Navier-Stokes will lead to non-linear acoustics models, which means that a turbulence/storm can generate sound wave.

a. How can we include rotation in early Universe model?

It has been known for long time that most of the existing cosmology models have singularity problem. Cosmological singularity has been a consequence of excessive symmetry of flow, such as "Hubble's law". More realistic one is suggested, based on Newtonian cosmology model but here we include the vortical-rotational effect of the whole Universe.

As shown in previous paper, we derived an Ermakov-type equation following Nurgaliev [26][27].

After he proceeds with some initial assumptions, Nurgaliev obtained a new simple local cosmological equation:[8][9] ,

$$\dot{H} + H^2 = \omega^2 + \frac{4\pi G}{3}\rho, \tag{3}$$

where $\dot{H} = dH/dt.$

The angular momentum conservation law ωR^2 = const = K and the mass conservation law $(4\pi/3)\rho R^3$ = const = M makes equation (3) solvable:[26] ,

$$\dot{\mathrm{H}} + \mathrm{H}^2 = \frac{K^2}{R^4} - \frac{\mathrm{GM}}{\mathrm{R}^3}, \tag{4}$$

or

$$\ddot{R} = \frac{K^2}{R^3} - \frac{GM}{R^2} \tag{5}$$

Equation (5) may be written as Ermakov-type nonlinear equation as follows; .

$$\ddot{R} + \frac{GM}{R^2} = \frac{K^2}{R^3} \tag{6}$$

Nurgaliev tried to integrate equation (5), but we solved the above equation numerically. The results are as follows: First, we rewrite this equation by replacing GM=A, K^2=B, so we get an expression of Ermakov equation:[26] .

$$\ddot{R} + \frac{A}{R^2} = \frac{B}{R^3}. \tag{7}$$

As with what Nurgaliev did, we also tried different sets of A and B values, as follows:

a. A and B < 0

```
A
B=-10;
ODE=x''[t]+A/x[t]^2-B/x[t]^3==0;
sol=NDSolve[{ODE,x[0]==1,x'[0]==1},x[t],{t,-10,10}]
Plot[x[t]/.sol,{t,-10,10}]
```

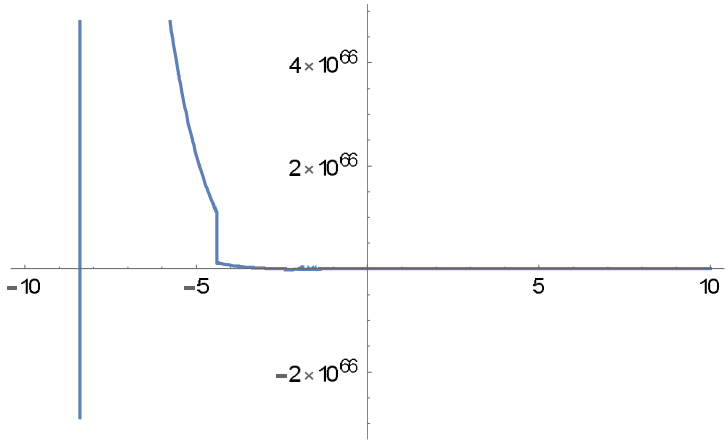

Figure 1. Plot of Ermakov-type solution for A=-10, B=-10 [5]

b. A > 0, B < 0

```
A=1;
B=-10;
ODE=x''[t]+A/x[t]^2-B/x[t]^3==0;
sol=NDSolve[{ODE,x[0]==1,x'[0]==1},x[t],{t,-10,10}]
Plot[x[t]/.sol,{t,-10,10}] 10 5 5 10
```

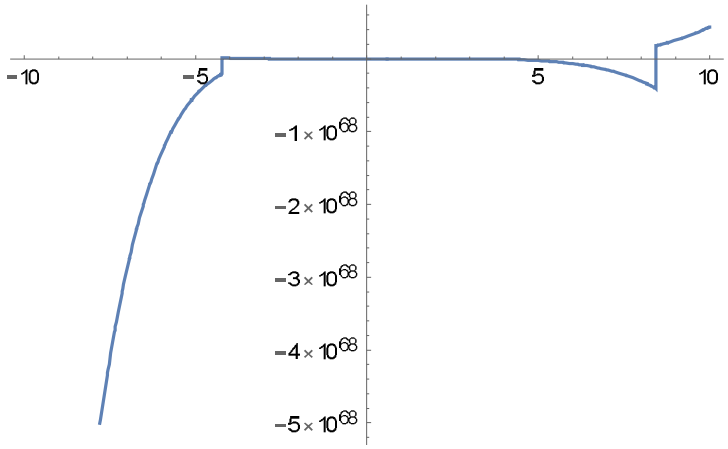

Figure 2. Plot of Ermakov-type solution for A=1, B=-10 [5]

From the above numerical experiments, we conclude that the evolution of the Universe depends on the constants involved, especially on the rotational-vortex structure of the Universe. This needs to be investigated in more detailed for sure.

One conclusion that we may derive especially from Figure 2, is that our computational simulation suggests that it is possible to consider that the Universe has existed for long time in prolonged stagnation period, then suddenly it burst out from *empty and formless* (Gen. 1:2), to take its current shape with accelerated expansion.

As an implication, we may arrive at a precise model of flattening velocity of galaxies without having to invoke *ad-hoc* assumptions such as dark matter.

Therefore, it is perhaps noteworthy to discuss briefly a simple model of galaxies based on a postulate of turbulence vortices which govern the galaxy dynamics. The result of Vatistas' model equation can yield prediction which is close to observation, as shown in the following diagram:[10]

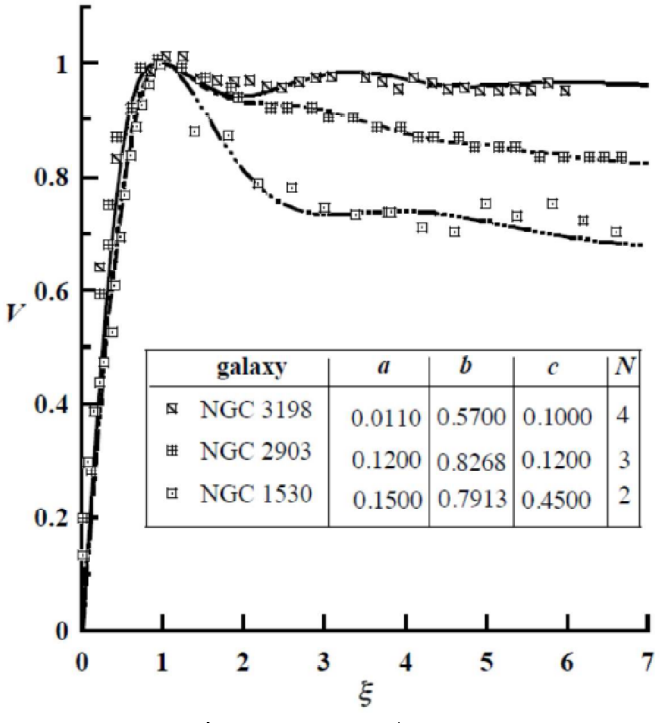

Figure 3. From Vatistas [10]

Therefore it appears possible to model galaxies without invoking numerous *ad hoc* assumptions such as *dark matter*, once we accept the existence of turbulent interstellar medium. The Vatistas model is also governed by Navier-Stokes equations, see for instance [10].

b. How "turbulence-generated sound" can be put into a mathematical model for the early Universe

We are aware that the notion of turbulence-generated sound is not new term at all especially in aerodynamics, but the term is rarely used in cosmology until now. We will consider some papers where it can be shown that 3D Navier-Stokes will lead to *non-linear acoustics models*, which means that a turbulence/storm can generate sound wave.

In this section we consider only two approaches:

- Shugaev-Cherkasov-Solenaya's model: They investigate acoustic radiation emitted by three-dimensional (3D) vortex rings in air on the basis of the unsteady Navier–Stokes equations. Power series expansions of the unknown functions with respect to the initial vorticity which is supposed to be small are used. In such a manner the system of the

  Navier–Stokes equations is reduced to a parabolic system with constant coefficients at high derivatives. [11]
- Rozanova-Pierrat's Kuznetsov equation: she analysed the existing derivation of the models of non-linear acoustics such as the Kuznetsov equation, the NPE equation and the KZK equation. The technique of introducing a corrector in the derivation ansatz allows to consider the solutions of these equations as approximations of the solution of the initial system (a compressible Navier-Stokes/Euler system). The direct derivation shows that the Kuznetzov equation is the first order approximation of the Navier-Stokes system, the KZK and NPE equations are the first order approximations of the Kuznetzov equation and the second order approximations of the Navier-Stokes system. [12]

Remark on Neutrosophic Logic perspective and implications

It seems obvious, how this new scenario is quite in agreement with Kant's idea that it is possible that the Universe has both finite history in the past and also eternal background (our new term: "*time before time*"); see [6]. We also discussed how such a mixed view can be modelled by introducing rotation in the early universe; see in particular Fig. 2.

Now there is an immediate question: Is this new look at the origin of Universe justifiable logically, or is it merely a compromised solution?

So, in this chapter we will review Neutrosophic Logic, a new theory developed in recent decades by one of these authors (FS). In this context, allow us to argue in favor of Neutrosophic logic as o ne basic

postutale, in lieu of the Aristotle logic which creates many problems in real world.

In Neutrosophy, we can connect an idea with its opposite idea and with its neutral idea and get common parts, i.e. <A> /\ <nonA> = nonempty set. The common part of the uncommon things!

It is true/real... paradox. From neutrosophy, all started: neutrosophic logic, neutrosophic set, neutrosophic probability, neutrosophic statistics, neutrosophic measure, neutrosophic physics, neutrosophic algebraic structures etc. It is true in restricted case, i.e. the Hegelian dialectics considers only the dynamics of opposites (<A> and <antiA>), but in our everyday life, not only the opposites interact, but the neutrals <neutA> between them too. For example: you fight with a man (so you both are the opposites). But neutral people around both of you (especially the police) interfere to reconcile both of you. Neutrosophy considers the dynamics of opposites and their neutrals.

So, neutrosophy means that: <A>, <antiA> (the opposite of <A>), and <neutA> (the neutrals A neutrosophic set is characterized by a between <A> and <antiA>) interact among themselves. truth-membership function (T), an indeterminacy-membership function (I), and a falsity-membership function (F), where T, I, F are subsets of the unit interval [0, 1].

As particular cases we have: single-valued neutrosophic set {when T, I, F are crisp numbers in [0, 1]}, and interval-valued neutrosophic set {when T, I, F are intervals included in [0, 1]}. Neutrosophic Set is a powerful structure in expressing indeterminate, vague, incomplete and inconsistent information. See [16]-[18].

To summarize, Neutrosophic Logic studies the dynamics of opposites and neutralities. And from this viewpoint, we can understand that it is indeed a real possibility that the Universe has both initial start (creation) but with eternal background. This is exactly the picture we got after our closer look at Gen. 1:1-2 as discussed in the above section.

In other words, our proposed term of Kantian "*time before time*" has sufficient logical background, especially in turbulence Universe model. This new interpretation of cosmic dynamics can be considered as Neutrosophic Logic application in cosmology studies, see also our previous article [32].

In the next section, we will consider some advantages of this new model of Universe.

Advantages of our Turbulence Universe model

Now, allow us to discuss some advantages of the proposed turbulence cosmology view over the Lemaitre's primeval atom (which is the basis of Standard Model Cosmology); see [13]-[15].

a. Avoid inflationary scheme

It is known that inflationary models were proposed by Alan Guth et al. (see [19][20]), in order to explain certain difficulties in the Big Bang scenario. But some cosmology experts such as Hollands & Wald has raised some difficulties with inflationary model, as follows:

> "We argue that the explanations provided by inflation for the homogeneity, isotropy, and flatness of our universe are not satisfactory, and that a proper explanation of these features will require a much deeper understanding of the initial state of our universe."[21]

In our diagram plot above, it is clear that an early rotation model can explain why the Universe can burst out into creation in a very short period, without invoking *ad hoc* postulate such as inflation model.

b. Explain the observed late accelerated expansion.

As far as we know, one of the earliest models which gave prediction of accelerated expanding Universe is Carmeli's Cosmological General Relativity.[23]

But it has been shown by Green & Wald that for the large scale structures of the Universe, Newtonian model can give similar results compared to general relativity picture.[22]

Furthermore, it seems that there is no quite clear arguments why we should accept Carmeli use of 5D metric model (*space-time-velocity metric*). In the meantime, in our rotating Universe model, we do not invoke *ad hoc* dimension into the metric.

c. Explain inhomogeneity, breeding galaxies etc.

Astronomers have known for long time, that the Universe is not homogeneous and isotropic as in the usual model. It contains of inhomogeneity, irregularities, clumpiness, voids, filaments etc,, which indicate complex structures. Such inhomogeneous structures may be better modelled in terms of turbulence model such as Navier-Stokes equations, see also our early papers [7][8], also [10].

Conclusions

In this paper we start with reviewing Lidsey's work on connection between Ermakov-Pinney equation with cosmology schemes, then we also review his further work which attempts to establish the connection with BEC experiments in lab and cosmology setting.

Nonetheless, our additional note in this paper is pertaining to the use of similar Ermakov equation in Newtonian Universe with vortex, which indicates early universe with rotation can be modeled using Ermakov equation instead of trying to modify Friedmann equation for *rotating metric*.

In retrospect, noting similarity between EP equation in Lidsey's work and ours; it seems to indicate that it is possible to consider a turbulence Universe in terms of BEC experiments too. (It may be worth noting here, that superfluid vortex dynamics may be modelled in classical turbulence too, but it is beyond the scope of this paper).

That is why, we call this approach: "*one note samba*" approach to cosmology. Further investigation and experiment are recommended in this direction.

Acknowledgment

The first author would like to express his gratitude to Prof. Alexander Yefremov and Prof. M. Fil'chenkobv who gave him special occasion to join the Institute of Gravitation and Cosmology (IGC) at Peoples's Friendship University of Russia, back in 2008-2009. This paper is dedicated to Prof. Yu P. Rybakov, formerly head of Theoretical Physics Dept. at Faculty of Mathematical Physics, Peoples's Friendship University of Russia (RUDN), Moscow.

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Towards Gross-Pitaevskiian Description of Solar System & Galaxies

Victor Christianto[1*], Florentin Smarandache[2] & Yunita Umniyati[3]

[1]Malang Institute of Agriculture (IPM), Malang, Indonesia
[2]Dept. of Math. Sci., Univ. of New Mexico, Gallup, USA
[3]Dept. Mechatronics, Swiss-German Univ., Tangerang, Indonesia

***Correspondence**:
Victor Christianto, Malang Institute of Agriculture (IPM),
Malang, Indonesia.
Email: victorchristianto@gmail.com

Abstract

In this paper, we argue that Gross-Pitaevskii model can be a more complete description of both solar system and spiral galaxies, especially taking into account the nature of chirality and vortices in galaxies. We also hope to bring out some correspondence among existing models, e.g., the topological vortex approach, Burgers equation in the light of KAM theory, and the Cantorian Navier-Stokes approach. We hope further investigation can be done around this line of approach.

Keywords: Solar system, galaxy, Gross-Pitaevskii, Burgers equation, Navier-Stokes equation.

1. Introduction

From time to time, astronomy and astrophysics discoveries have opened our eyes that the Universe is much more complicated than what it seemed in 100-200 years ago. And despite all pervading popularity of General Relativistic extension to Cosmology, it seems still worthy to remind us to old concepts of Cosmos, for instance the *Hydor theory of Thales* ("that water is the essential element in the Cosmos")[3], and also Heracleitus ("ta panta rhei kai ouden menei").[4] Therefore, we can ask: does it mean that the Ultimate theory that we try to find should correspond to hydrodynamics or some kind of turbulence theory?

An indicator of complex turbulence phenomena in Our Universe is the Web like structure. *The Cosmic Web* is the fundamental spatial organization of matter on scales of a few up to a hundred Megaparsec. Galaxies and intergalactic gas matter exist in a wispy web-like arrangement of dense compact clusters, elongated filaments, and sheet-like walls, amidst large near-empty void regions. The filaments are the transport channels along which matter and galaxies flow into massive high-density cluster located at the nodes of the web. The web-like network is shaped by the tidal force field accompanying the inhomogeneous matter distribution.

May be part of that reason that in recent years, there is growing interest to describe the Universe we live in from the perspective of scale-invariant turbulence approach. Such an approach is not limited to hydrodynamics Universe model a la Gibson & Schild, but also from Kolmogorov turbulence approach as well as from String theory approach (some researchers began to explore String-Turbulence).

3 https://www.philosophy.gr/presocratics/thales.htm

4 https://carinawestling.wordpress.com/2010/12/03/τὰ-πάντα-ῥεῖ-καὶ-οὐδὲν-μζνει-ta-panta-rhei-kai-ouden-menei/

Recently, Pitkanen describes a solar system model inspired by spiral galaxies [1-2]. While we appreciate his new approach, we find it lacks discussion on the nature of vortices and chirality in galaxy.

In this article, we show some correspondences among existing models, so we discuss shortly, the topological vortice approach, Burgers equation in the light of KAM theory and Golden Mean, and the Cantorian Navier-Stokes approach. We will point out how vortices, turbulence and chirality nature of galaxies seem to suggest a quantised vortex approach, which in turn it corresponds to Gross-Pitaevskiian description.

2. Quantised vortices approach (see also ref. [42-43])

Here we present Bohr-Sommerfeld quantization rules for planetary orbit distances, which results in a good quantitative description of planetary orbit distance in the solar system [6][6b][7]. Then we find an expression which relates the torsion vector and quantized vortices from the viewpoint of Bohr-Sommerfeld quantization rules [3]. Further observation of the proposed quantized vortices of superfluid helium in astro-physical objects is recommended.

Bohr-Sommerfeld quantization rules and quantized vortices

Sonin's book [42] can be paraphrased as follows:

> The movement of vortices has been a region of study for over a century. During the old style time of vortex elements, from the late 1800s, many fascinating properties of vortices were found, starting with the outstanding Kelvin waves engendering along a disconnected vortex line (Thompson, 1880). The primary object of hypothetical investigations around then was a dissipationless immaculate fluid (Lamb, 1997). It was difficult for the hypothesis to find a shared opinion with try since any old style fluid shows gooey impacts. The circumstance changed after crafted by Onsager (1949) and Feynman (1955) who uncovered that turning superfluids are strung by a variety of vortex lines with quantised dissemination. With this revelation, the quantum time of vortex elements started.

The quantization of circulation for nonrelativistic superfluid is given by [3]:

$$\oint v dr = N \frac{\hbar}{m_s} \tag{1}$$

where

sm$N$, $\hbar$, m_s represents winding number, reduced Planck constant, and superfluid particle's mass, respectively [3]. And the total number of vortices is given by [44]:

$$N = \frac{\omega . 2\pi r^2 m}{\hbar} \tag{2}$$

And based on the above equation (2), Sivaram & Arun [44] are able to give an estimate of the number of galaxies in the universe, along with an estimate of the number stars in a galaxy.

However, they do not give explanation between the quantization of circulation (3) and the quantization of angular momentum. According to Fischer [3], the quantization of angular momentum is a relativistic extension of quantization of circulation, and therefore it yields Bohr-Sommerfeld quantization rules.

Furthermore, it was suggested in [6] and [7] that Bohr-Sommerfeld quantization rules can yield an explanation of planetary orbit distances of the solar system and exoplanets. Here, we begin with Bohr-Sommerfeld's conjecture of quantization of angular momentum. As we know, for the wavefunction to be well defined and unique, the momenta must satisfy Bohr-Sommerfeld's quantization condition:

$$\oint_{\Gamma} p.dx = 2\pi . n\hbar, \tag{3}$$

for any closed classical orbit Γ. For the free particle of unit mass on the unit sphere the left-hand side is:

$$\int_0^T v^2 . d\tau = \omega^2 . T = 2\pi . \omega, \tag{4}$$

where $T = \frac{2\pi}{\omega}$ is the period of the orbit. Hence the quantization rule amounts to quantization of the rotation frequency (the angular momentum): $\omega = n\hbar$

Then we can write the force balance relation of Newton's equation of motion:

$$\frac{GMm}{r^2} = \frac{mv^2}{r} \tag{5}$$

Using Bohr-Sommerfeld's hypothesis of quantization of angular momentum (4), a new constant g was introduced:

$$mvr = \frac{ng}{2\pi}. \tag{6}$$

Just like in the elementary Bohr theory (just before Schrodinger), this pair of equations yields a known simple solution for the orbit radius for any quantum number of the form:

$$r = \frac{n^2.g^2}{4\pi^2.GMm^2}, \tag{7}$$

or

$$r = \frac{n^2.GM}{v_o^2}, \tag{8}$$

where r, n, G, M, v_0 represents orbit radii (semimajor axes), quantum number (n=1,2,3,...), Newton gravitation constant, and mass of the nucleus of orbit, and specific velocity, respectively. In equation (10), we denote:

$$v_0 = \frac{2\pi}{g} GMm \tag{9}$$

The value of m and g in equation (9) are adjustable parameters.

Interestingly, we can remark here that equation (8) is exactly the same with what is obtained by Nottale using his Schrödinger-Newton formula [8]. Therefore here we can verify that the result is the same,

either one uses Bohr-Sommerfeld quantization rules or Schrödinger-Newton equation. The applicability of equation (8) includes that one can predict new *exoplanets* (i.e., extrasolar planets) with remarkable result.

Therefore, one can find a neat correspondence between Bohr-Sommerfeld quantization rules and motion of quantized vortices in condensed-matter systems, especially in superfluid helium [3]. Here we propose a conjecture that superfluid vortices quantization rules also provide a good description for the motion of galaxies, especially with respect to their chirality nature, as will be discussed later.

3. Golden ratio is directly related to KAM turbulence via Burgers equation

The Cosmic Web is the fundamental spatial organization of matter on scales of a few up to a hundred Megaparsec. Galaxies and intergalactic gas matter exist in a wispy weblike arrangement of dense compact clusters, elongated filaments, and sheetlike walls, amidst large near-empty void regions. The filaments are the transport channels along which matter and galaxies flow into massive high-density cluster located at the nodes of the web. The weblike network is shaped by the tidal force field accompanying the inhomogeneous matter distribution.[15]

Structure in the Universe has risen out of tiny primordial (Gaussian) density and velocity perturbations by means of gravitational instability. The large-scale anisotropic force field induces anisotropic gravitational collapse, resulting in the emergence of elongated or flattened matter configurations. The simplest model that describes the emergence of structure and complex patterns in the Universe is the Zeldovich Approximation (ZA).[15]

It is our hope that the new approach of CA Adhesion model of the Universe can be verified either with lab experiments, computer simulation, or by large-scale astronomy observation data.

From Zeldovich Approximation to Burgers' equation to Cellular Automaton model

In this section, we will outline a route from ZA to Burgers' equation and then to CA model. The simplest model that describes the emergence of structure and complex patterns in the Universe is the Zeldovich Approximation (ZA). In essence, it describes a ballistic flow, driven by a constant (gravitational) potential. The resulting Eulerian position x(t) at some cosmic epoch t is specified by the expression[15]:

$$x(t) = q + D(t)u_o(q), \tag{10}$$

where q is the initial "Lagrangian" position of a particle, D(t) the time-dependent structure growth factor and

$$u_0 = -\nabla_q \Phi_0 \tag{11}$$

its velocity. The nature of this approximation may be appreciated by the corresponding source-free equation of motion,

$$\frac{\partial u}{\partial D} + (u \cdot \nabla_x)u = 0. \tag{12}$$

The use of ZA is ubiquitous in cosmology. One major application is its key role in setting up initial conditions in cosmological N-body simulations. Of importance here is its nonlinear extension in terms of Adhesion Model [15]:

The ZA breaks down as soon as self-gravity of the forming structures becomes important. To 'simulate' the effects of self-gravity, Gurbatov et al. included an artificial viscosity. This results in the Burgers' equation as follows [15]:

$$\frac{\partial u}{\partial D} + (u \cdot \nabla_x)u = \nu . \nabla_x^2 u, \tag{13}$$

a well known PDE from fluid mechanics. This equation has an exact analytical solution, which in the limit of

$$\phi(x, D) = \max_q \left[\Phi_0(q) - \frac{(x-q)^2}{2D} \right]. \tag{14}$$

This leads to a geometric interpretation of the Adhesion Model. The solution follows from the evaluation of the convex hull of the velocity potential modified by a quadratic term. We found that the solution can also be found by computing the weighted Voronoi diagram of a mesh weighted with the velocity potential. For more detailed discussion on Adhesion Model of the Universe, see for example [18].

Now, let us consider another routes to solve Burgers equation: (a) by numerical computation with *Mathematica*, see [17]; and (b) by virtue of CA approach. Let us skip route (a), and discuss less known approach of cellular automata.

We start with the Burgers' equation with Gaussian white noise which can be rewritten as follows [16]:

$$\frac{\partial u}{\partial t} + \xi = 2u\frac{\partial u}{\partial x} + \frac{\partial^2 u}{\partial x^2} + \eta. \tag{15}$$

By introducing new variables and after straightforward calculations, we have the automata rule [16]:

$$\phi_i^{t+1} = \phi_{i-1}^t + \max[0, \phi_i^t - A, \phi_i^t + \phi_{i+1}^t - B, \Psi_i^t - \phi_{i-1}^t]$$
$$- \max[0, \phi_{i-1}^t - A, \phi_{i-1}^t + \phi_i^t - B, \Phi_i^t + \phi_{i-1}^t] \tag{16}$$

In other words, in this section we give an outline of a plausible route from ZA to Burgers' equation then to CA model, which suggests that it appears possible –at least in theory- to consider a nonlinear cosmology based on CA Adhesion model.

From KAM theory to Golden section

Another possible way to describe the complex structure of Universe, is the Kolmogorov-Arnold-Moser (KAM) theorem, which states that if the system is subjected to a weak nonlinear perturbation, some of the invariant tori are deformed and survive, while others are destroyed. The ones that survive are those that have "sufficiently irrational frequencies" (the non-resonance condition, so they do not interfere with one another). The golden ratio being the most irrational number

is often evident in such systems of oscillators. It is also physically significant in that circles with golden mean frequencies are the last to break up in a perturbed dynamical system, so the motion continues to be quasi-periodic, i.e., recurrent but not strictly periodic or predictable.

An important consequence of the KAM theorem is that for a large set of initial conditions, the motion remains perpetually quasi-periodic, and hence stable. KAM theory has been extended to non-Hamiltonian systems and to systems with fast and slow frequencies.

Those KAM tori that are not destroyed by perturbation become invariant Cantor sets, or "Cantori". The frequencies of the invariant Cantori approximate the golden ratio. The golden ratio effectively enables multiple oscillators within a complex system to co-exist without blowing up the system. But it also leaves the oscillators within the system free to interact globally (by resonance), as observed in the coherence potentials that turn up frequently when the brain is processing information.

Obviously, this can be tied in to the creation of subatomic particles such as electrons and positrons. At a certain scale of smallness, the media in the local volume becomes isotropic, while larger volumes exhibit occupation by ever-larger turbulence formations and exhibit extremes of **an**isotropy in the media.

The Kolmogorov Limit is $10e^{-58}$ m, which is the smallest vortex that can exist in the aether media. Entities smaller than this, down to the SubQuantum infinitesimals (Bhutatmas) (vortex lines) are the primary cause of gravitation (a "sink" model of gravitation caused by superluminal infinitesimals).[5]

5 Thanks to discussions with Robert Neil Boyd, PhD.

Figure 1. Turbulent flow generated by the tip vortex of the aeroplane wing shown up by red agricultural dye. (after Mae Wan-Ho [38]).

Shadow gravity is valid in the situation of gravitational interaction between two discrete masses that divert the ambient gravitational flux-density away from each other. This happens due to absorption (rare), scattering (more common), and refraction (most of the time) of gravitational infinitesimals.

Gravitational flux density is a variable depending on stellar, interstellar, and intergalactic events. A simplified model of vorticity fields in large scale structures of the Universe is depicted below:

What is more interesting here, is that it can be shown that there is correspondence between Golden section and in coupled oscillators and KAM Theorem, but also between Golden section and Burgers equation. [35]. For more discussion, on Golden Mean and its ramifications, see for instance [39[40][41].

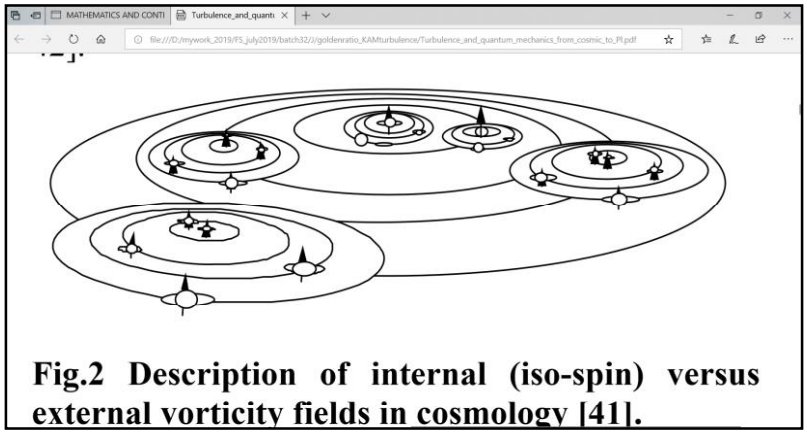

Figure 2. Vorticity fields in cosmology (after Siavash Sohrab [34]).

4. Cantorian Navier-Stokes approach

Vorticity as the driver of Accelerated Expansion

According to Ildus Nurgaliev [26], velocity vector V_α of the material point is projected onto coordinate space by the tensor of the second rank $H_{\alpha\beta}$:

$$V_\alpha = H_{\alpha\beta} R^\beta \tag{17}$$

where the Hubble matrix can be defined as follows for a homogeneous and isotropic universe:

$$H_{\alpha\beta} = \begin{pmatrix} H & \pm\omega & \pm\omega \\ \mp\omega & H & \pm\omega \\ \mp\omega & \mp\omega & H \end{pmatrix} \tag{18}$$

where the global average vorticity may be zero, though not necessarily [7]. Here the Hubble law is extended to 3x3 matrix.

Now we will use Newtonian equations to emphasize that cosmological singularity is consequence of the too simple model of the flow, and has nothing to do with special or general relativity as

a cause [26]. Standard equations of Newtonian hydrodynamics in standard notations read:

$$\frac{d\vec{\upsilon}}{dt}=\frac{\partial\vec{\upsilon}}{\partial t}+\vec{\upsilon}\nabla\vec{\upsilon}=-\nabla\varphi+\frac{1}{\rho}\nabla\rho+\frac{\mu}{\rho}\Delta\vec{\upsilon}+..., \tag{19}$$

$$\frac{\partial\rho}{\partial t}+\nabla\rho\vec{\upsilon}=0, \tag{20}$$

$$\Delta\varphi=4\pi G\rho \tag{21}$$

Procedure of separating of diagonal H, trace-free symmetrical σ, and anti-symmetrical ω elements of velocity gradient was used by Indian theoretician Amal Kumar Raychaudhury (1923-2005). The equation for expansion θ, sum of the diagonal elements of [7]:

$$\dot{\theta}+\frac{1}{3}\theta^2+\sigma^2-\omega^2=-4\pi G\rho+div(\frac{1}{\rho}\sum f) \tag{22}$$

is most instrumental in the analysis of singularity and bears the name of its author. [26]

System of (25)-(27) gets simplified up to two equations [26]:

$$\dot{\theta}+\frac{1}{3}\theta^2-\omega^2=0, \tag{23}$$

$$\dot{\omega}+\frac{2}{3}\theta\omega=0. \tag{24}$$

Recalling θ=3H the integral of (30) takes the form [26]:

$$H^2=H_\infty^2-\frac{3\omega_0^2R_0^4}{R^4}. \tag{25}$$

How to write down Navier-Stokes equations on Cantor Sets

Now we can extend further the Navier-Stokes equations to Cantor Sets, by keeping in mind their possible applications in cosmology.

By defining some operators as follows:

1. In Cantor coordinates [28]:

$$\nabla^{\alpha}\cdot u = div^{\alpha}u = \frac{\partial^{\alpha}u_1}{\partial x_1^{\alpha}} + \frac{\partial^{\alpha}u_2}{\partial x_2^{\alpha}} + \frac{\partial^{\alpha}u_3}{\partial x_3^{\alpha}}, \tag{26}$$

$$\nabla^{\alpha}\times u = curl^{\alpha}u = \left(\frac{\partial^{\alpha}u_3}{\partial x_2^{\alpha}} - \frac{\partial^{\alpha}u_2}{\partial x_3^{\alpha}}\right)e_1^{\alpha} + \left(\frac{\partial^{\alpha}u_1}{\partial x_3^{\alpha}} - \frac{\partial^{\alpha}u_3}{\partial x_1^{\alpha}}\right)e_2^{\alpha} + \left(\frac{\partial^{\alpha}u_2}{\partial x_1^{\alpha}} - \frac{\partial^{\alpha}u_1}{\partial x_2^{\alpha}}\right)e_3^{\alpha} \tag{27}$$

2. In Cantor-type cylindrical coordinates [29, p.4]:

$$\nabla^{\alpha}\cdot r = \frac{\partial^{\alpha}r_R}{\partial R^{\alpha}} + \frac{1}{R^{\alpha}}\frac{\partial^{\alpha}r_{\theta}}{\partial\theta^{\alpha}} + \frac{r_R}{R^{\alpha}} + \frac{\partial^{\alpha}r_z}{\partial z^{\alpha}}, \tag{28}$$

$$\nabla^{\alpha}\times r = \left(\frac{1}{R^{\alpha}}\frac{\partial^{\alpha}r_{\theta}}{\partial\theta^{\alpha}} - \frac{\partial^{\alpha}r_{\theta}}{\partial z^{\alpha}}\right)e_R^{\alpha} + \left(\frac{\partial^{\alpha}r_R}{\partial z^{\alpha}} - \frac{\partial^{\alpha}r_z}{\partial R^{\alpha}}\right)e_{\theta}^{\alpha} + \left(\frac{\partial^{\alpha}r_{\theta}}{\partial R^{\alpha}} + \frac{r_R}{R^{\alpha}} - \frac{1}{R^{\alpha}}\frac{\partial^{\alpha}r_R}{\partial\theta^{\alpha}}\right)e_z^{\alpha} \tag{29}$$

Then Yang, Baleanu and Machado are able to obtain a general form of the Navier-Stokes equations on Cantor Sets as follows [28, p.6]:

$$\rho\frac{D^{\alpha}\upsilon}{Dt^{\alpha}} = -\nabla^{\alpha}\cdot(pI) + \nabla^{\alpha}\left[2\mu\left(\nabla^{\alpha}\cdot\upsilon + \upsilon\cdot\nabla^{\alpha}\right) - \frac{2}{3}\mu\left(\nabla^{\alpha}\cdot\upsilon\right)I\right] + \rho b \tag{30}$$

The next task is how to find observational cosmology and astrophysical implications. This will be the subject of future research.

5. Correspondence with Gross-Pitaevskiian description and a description of chirality nature of galaxies

In this section we will point out how vortices and chirality nature of galaxies seem to suggest a superfluid vortex approach, which in turn it corresponds to Gross-Pitaevskiian description. The nature and origin of chirality in galaxies remain an elusive topic to explain. However we can recall some recent works to suggest an explanation.

First of all, let us quote from abstract of a recent paper [9], where Tapio Simula wrote, which can be rephrased as follows:

> Right now, and electromagnetism have a similar starting point and are new properties of the superfluid universe, which itself rises up out of the hidden aggregate structure of progressively basic particles, for example, atoms.

The Bose–Einstein condensate is identified as the tricky dull matter of the superfluid universe with vortices and phonons, separately, comparing to huge charged particles and massless photons.

In lieu of his model of electromagnetic and gravitation fields in terms of superfluid vortices, we can also come up with a model of chirality in cosmology from Proca equations. As Proca equations can be used to describe electromagnetic field of superconductor, we find it as a possible approach too [45].

Now we are going to discuss how it can be used as a model of chirality nature of galaxies. Cappoziello and Lattanzi argue that spiral galaxies are axi-symmetric objects showing 2D-chirality when projected onto a plane [36]. In their enantiomers model, chirality in spiral galaxies and chirality Spiral galaxies are axi-symmetric objects showing 2D-chirality when projected onto a plane, and their progressive loss of chirality surrounding its galaxy center, can point out of vorticity in superfluidity.

See the following figure, which is quite in agreement with Figure 2 by Sohrab:

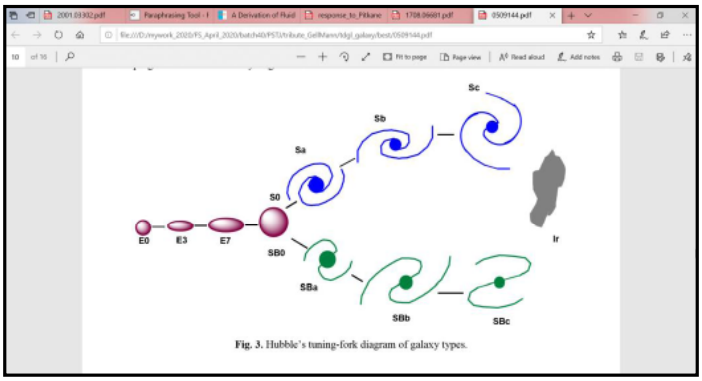

Figure 3. After Cappoziello & Lattanzi [36].

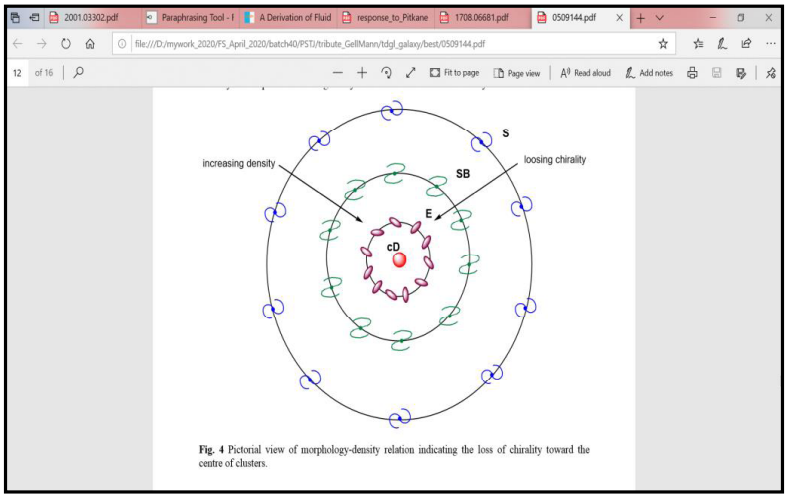

Figure 4. Progressive loss of chirality. After Cappoziello & Lattanzi [36].

With regards to question posed above: what kind of medium of interaction capable of doing such a quantal action? Allow us to quote from Fernandez-Hernandez et al's abstract [37], which can be paraphrased as follows:

> The ultra-light scalar fields are likewise called scalar field dull issue model. Right now study turn bends for low surface brilliance winding cosmic systems utilizing two scalar field models: the Gross-Pitaevskii *Bose-Einstein condensate in the Thomas-Fermi estimation* and a scalar field arrangement of the Klein-Gordon condition. We additionally utilized the zero circle guess universe model where photometric information isn't thought of.

Therefore, we come up with a conclusion that it seems *Gross-Pitaevskiian description of Bose-Einstein condensate is necessary for correct modelling of spiral and non-spiral galaxies*. Interestingly, in two rather old papers both of us (VC & FS) have argued for derivation of Schrödinger equation model of planetary orbits of solar system from TDGL (Gross-Pitaevskii) description [46-47]. Therefore, it seems we can arrive at this conclusion: it is possible to come up with consistent description of both solar system and galaxy dynamics, including its chirality and rotation curves, by virtue of Gross-Pitaevkiian description of BEC/superfluidity.

6. Conclusion

In this paper, we have discussed several approaches in description of planetary systems as well as galaxies. Sections 2-4 have been presented in earlier papers.

Therefore, we come up with a conclusion that there are sufficient grounds to argue in favour of Gross-Pitaevskiian description of Bose-Einstein condensate; i.e. it is necessary for correct modelling of spiral and non-spiral galaxies. Interestingly, in a rather old paper both of us (VC & FS) have argued for derivation of Schrodinger equation model of planetary orbits of solar system from TDGL (Gross-Pitaevskii) description.

Summarizing, it seems we can arrive at this conclusion: it is possible to come up with consistent description of both solar system and galaxy dynamics, *including its chirality and rotation curves, by virtue of Gross-Pitaevkiian description of BEC*.

Of course, this short article is far from being complete. We hope further investigation can be done around this line of approach. The remaining questions include how to find observational cosmology and astrophysical implications. Future research is recommended.

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A Data-Driven Approach to Astrophysics: Towards Quantum Geophysics and Quantum Astrophysics

Victor Christianto[1*]

Author's Affiliations:
Victor Christianto,
[1]Malang Institute of Agriculture (IPM),
Jl. Soekarno-Hatta, Indonesia.
*Initiator, Halton Arp Institute, with affiliation to International Mariinskaya Academy, St. Petersburg.

Corresponding author:
Victor Christianto, Malang Institute of Agriculture (IPM),
Jl. Soekarno-Hatta, Indonesia
E-mail: victorchristianto@gmail.com
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Abstract

Following our previous article which recommends physicists to build models in the light of principle of parsimony, and also a review on A. Yefremov's research in the past few years (PSTJ, 2021), here we discuss a data-driven approach to astrophysics. Part of inspiration for this article came from a paper by Brunton, Proctor & Kutz (PNAS, April 12, 2016) and also lecture by the late Hannes Alfven. We begin with a review on how Newton's recipe to interpret Kepler's elliptical orbit law, actually led to a number of problematic questions. While we agree with Alfven that one should not infer the history of solar system just from the nature of planetary orbits (or deviations from that), and not from other present astronomy data, because those present data may be of little value to reveal the past history; instead from the data and improving Titius-Bode law, therefore we suggest to come up with a new hypothesis: "*quantum matter inside a Newtonian universe*." In other words, in the second section we will discuss how quantum geophysics and quantum astrophysics emerge into the scene.

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Introduction

There are some really interesting remarks that we can read from the late Hannes Alvfen's Nobel lecture in 1970. Among other things, he wrote that one should not infer the history of solar system just from the nature of planetary orbits (or deviations from that), and also not from other present astronomy data, because those present data may be of little value to reveal the past history of solar system. He also suggests a new term: "*hetegony*", which can be interpreted as description on how things are arranged or paired together. [1]

In this context, in this paper we will discuss how we can rethink a data-driven approach in astrophysics. Brunton, Proctor & Kutz wrote

to summarize how such an approach is of significance in science and also in engineering in general, which can be paraphrased as: “Removing overseeing conditions from information is a focal test in numerous assorted spaces of science and designing. Information are bountiful though models regularly stay slippery, as in environment science, neuroscience, biology, money, and the study of disease transmission, to give some examples models. In this work, we join sparsity-advancing methods with nonlinear dynamical frameworks to find administering conditions from uproarious estimation information.” [2]

Of course, first of all we shall discuss how Kepler reported his study of planetary motions in the solar system, which led him to come up with his three laws. To quote Brunton *et al*. [2], which can be paraphrased as follows:

“Kepler, outfitted with the most broad and exact planetary data of the period, fostered an information driven model for planetary movement, resulting in his renowned elliptic circles. Notwithstanding, this was an attractor-based perspective on the world, and it didn’t clarify the principal dynamic connections that bring about planetary circles, or give a model to how these bodies respond when irritated. Newton, in contrast, found a uniqueconnection between force and energy that depicted the basic cycles answerable for these elliptic circles.”[2]

Nonetheless, in the light of three problems which appear persistently even since Newton era, namely:

Bentley’s problem, Zwicky’s dark matter problem, and accelerated expansion or more known as dark energy problem, and also from the data and improving Titius-Bode law, in the second section we suggest to come up with a new hypothesis: “*quantum matter inside a Newtonian universe*.”

In other words, we will discuss how quantum geophysics and quantum astrophysics emerge into the scene, more or less based on reading the data themselves. This approach seem like repeating what

Kepler himself did, especially if he lives today and got new collection of astrophysics data which were not available in his time.

A. From Kepler to Newton to Zwicky

A.1. Short review of Kepler's result

Tycho Brahe at the time was a master of observation of celestial bodies by his new telescope. But later on he recruited a young assistant, Johannes Kepler. In 1609, Johannes Kepler revealed that the planet Mars moves in a circular circle. What sort of power makes a planet move in a circular way? What is the power law – the law that indicates how the power F(r) relies upon the distance r between the Sun and the planet? This Kepler issue tested the regular rationalists of the seventeenth century.[3]

A.2. Newton's interpretation

Newton's proof of the connection between elliptical orbits and inverse-square forces ranks among the "top ten" calculations in the history of science. Isaac Newton solved Kepler problem in his *Mathematical Principles of Natural Philosophy*, published in 1687. [3]

J. Prentis et al. [3] argue that there is the so-called Newton's Recipe which anyone can follow:

> "Newton's Recipe depends on a secret jewel in Newton's *Principia*—the "PQRST Formula," which is a basic mathematical adaptation of F = m.a. Given any sort of orbital bend (curved, twisting, and so on), this recipe permits one to reason the power just by estimating the lengths of three line sections—the "shape boundaries" of the circle."[3]

J.Prentis et al. also explain further what are the steps in Newton's recipe, which can paraphrased as follows:

> Given just two ingredients the state of the circle and the focal point of the power—"Newton's Recipe" permits one to compute the general power at any orbital point. The formula comprises of following advances:

1. *The inertial path*: Draw the digression line to the circle bend at the point P where the power is to be determined.
2. *The future point*: Locate any future point Q on the circle that is near the underlying point P.
3. *The deviation line*: Draw the line portion from Q to R, where R is a point on the digression, to such an extent that QR (line of deviation) is corresponding to SP (line of power).
4. *The time limit*: Draw the line section from Q to T, where T is a point on the spiral line SP, with the end goal that QT (stature of "time triangle") is opposite to SP (base of triangle).
5. *The force measure*: Measure the shape boundaries QR, SP, and QT, and compute the power measure QR/(SP x QT).
6. *The calculus limit*: Repeat stages two to five for a few future focuses Q around P to get a few power measures. Take the cutoff Q→P of the succession of power measures to track down the specific worth of the power measure at P.

The above steps summarize Newton's steps to prove that there is a dynamical force, or the so-called *governing equations* for planetary orbits around the Sun. That would mean that at the time Kepler and Newton followed a data-driven approach to solar system.

But is that correct inlight of more precise measurements? It is known, that even in Newton's era there were critics to his theory.

A.3. Three problems up to present

A.3.a. Bentley's paradox

As Michio Kaku wrote about the paradox:

But Newton's theory also reveals paradoxes that inherent in the theory of a finite or infinite universe. Simple questions lead to chaos contradiction. Even while Newton rejoices with fame thanks to the publication of the *Principia*, he discovered that his theory of gravity no doubt filled with paradoxes. In 1692, a priest, Rev. Richard Bentley, wrote a simple but troublesome letter to Newton.

After careful thought, Newton wrote back that he find loopholes in the argument. He prefers nature the universe is infinite but uniform. Thus, if a star being dragged to the right by an infinite number of stars infinity, this is thwarted by the equivalent drag of the star sequence another infinity in the other direction. All styles are balanced in each direction, resulting in a static universe. So, if gravity always attract, the only solution to the Bentley paradox is natureinfinite but uniform universe.Newton did find a loophole in Bentley's argument. But Newton was smart enough to realize the weakness of his answer alone. He admitted in a letter that the solution was not solid, though technically correct. [4]

A.3.b. Zwicky

Another observation made by Fritz Zwicky around 1930s, who suggested that the galaxy does not follow the Newton's law. It seems more like flat instead of following the inverse square law. There seems to be a large mass, which then it is called "dark matter." The problem is : despite so many theories of dark matter have been proposed, including MOND etc., but most of them cannot be detected nor observed in lab. There is something really missing here.

A.3.c. Accelerated expansion / dark energy

If the above two problems are quite perplexing, there is more perplexing problem: dark energy or mysterious force which accelerates the expansion of the universe. Along with dark matter, dark energy seems also repel most theoretical models.

The above three problems make us wondering if there is something missing not only in General Relativity scenario, which was set by Einstein to give more or less same result to Newton in limiting cases.

B. Another Approach to Data-Driven Modeling

Therefore, let us begin from a fresh starting point: Since 1700s, there were two scientists who suggest pattern of orbit distances, known

as Titius-Bode law. Albeit their method is different from Kepler's observation, but nonetheless these are also data which have value in themselves to be studied.

And many papers have been written on the physical meaning of Titius-Bode law, especially with respect to *Old Quantum Theory* of Bohr and Sommerfeld (before 1920s) and also to *New Wave Mechanics* of Schrodinger etc. In other words, does it mean we shall begin to consider a quantum version of astrophysics? Or to speak more precisely: can we speak of *a quantum explanation* of planetary orbit distances?

Definition of quantum astrophysics: "The uses of quantum mechanical principles to describe astrophysical phenomena and processes."[6]

Question: Which quantum mechanical principles are applicable to large-scale astrophysical bodies?

Remark: With the above question, we point out that there are several different approaches of QM, and even the meaning of quantum wave function in wave mechanics, remains a debatable issue among experts. And which interpretation of quantum wave function corresponds better to quantum phenomena, such as planetary orbit distances? We will discuss this topic in our paper: "*Dialogue between two chief worldview systems*..." (forthcoming).

In this regards, allow us to tell a story of us. We will review the work and results during the past 17 years or so. The basic assumption here is that the Solar System's planetary orbits are quantized. But how do their orbits behave? Do they follow Titius-Bode's law? Our answer can be summarized as follows:

Navier-Stokes equations $\rightarrow$ superfluid quantized vortices $\rightarrow$
Bohr's quantization rule (1)

6 Note: Actually this term is not really new, as McCrea has discussed quantum mechanical laws in astrophysics, back then around 1950s. See also for instance: Elena Muchikova, Astrophysical Applications of Quantum Mechanics, PhD dissertation submitted to Caltech, 29th May 2018.

Our predictive model based on that scheme has yielded some interesting results which may be comparable with the observed orbits of planetoids beyond Pluto, including what then was dubbed as Sedna. And it seems that the proposed model is slightly better compared to Nottale-Schumacher's gravitational Schrödinger model and also Titius-Bode's empirical law. (*Note*: Prof. Laurent Nottale is a senior astronomer *at Observatoire de Paris, Meudon, France*.) See table 1 below.

Table 1: Comparison between Laurent Nottale's results, Titius-Bode law, CSV, and observed data

Object	**No**	**Titius-Bode**	**L. Nottale** (in 10 AU unit)	**CSV** (in 10 AU unit)	**Observed** (in 10 AU unit)
-	1		0.4	0.43	
-	2		1.7	1.71	
Mercury	3	4	3.9	3.85	3.87
Venus	4	7	6.8	6.84	7.32
Earth	5	10	10.7	10.70	10.00 (1 AU)
Mars	6	16	15.4	15.4	15.24
Hungarias	7	-	21.0	20.96	20.99
Asteroids	8	-	27.4	27.38	27.00
Camilla	9	-	34.7	34.6	31.5
Jupiter	2	52	-	45.52	52.03
Saturn	3	100	-	102.4	95.39
Uranus	4	196	-	182.1	191.9
Neptune	5	-	-	284.5	301
Pluto	6	388	-	409.7	395
2003EL61	7	-	-	557.7	520
Sedna	8	722	-	728.4	760
2003UB31	9	-	-	921.8	970

(Source: After V. Christianto, *Apeiron*, July 2004. URL: http://redshift.vif.com) [6].

The above evidences of quantization of planetary orbit distances seem to suggest to *wave mechanics model at large scale*. [6-11] See also Peter Coles [12].

C. Towards Quantum Geophysics And Quantum Astrophysics

C.1. Quantum Geophysics

It is known that most Professors and college students would write Newton gravitation law as follows:

$$F=m.a \quad (2)$$

But that is only half correct. The correct definition provided by Newton is that gravitation force is the *rate of change of momentum*, or:

$$F=dp/dt \quad (3)$$

Or we can write:

$$F=d[mv]/dt \quad (4)$$

Or

$$F=m.dv/dt + v.dm/dt \quad (5)$$

In other words, there can be certain processes where rest mass of the celestial bodies can vary, i.e. it is called varying mass. Recent paper suggesting hydrodynamics description of gravity also provides a possible mechanism of expanding earth and red shift. [16]

In literature, there are some proposals on what kind of plausible mechanisms for such a *matter-creation* process, for instance VMH (*variable mass hypothesis*) of Narlikar & Arp, and later on C-field model of Prof. Jayant Narlikar, but there can be more advanced explanations, such as *neutron repulsion* behind the inner core of the Sun (and may be also in Earth and other planets) as proposed by Kuroda-Manuel, and low energy nuclear reaction, or even some kind of biological-like transmutation, as discussed by Louis Kervlar and J.P. Biberian (see J.P. Biberian's papers at JCMNS). This topic deserves a separate paper, so we will discuss later on.

Going back to our data-driven approach, such an expanding earth hypothesis may be associated to Pangaea hypothesis, which is known to *paleo-geology* studies etc. See some figures below.

Figure 1:

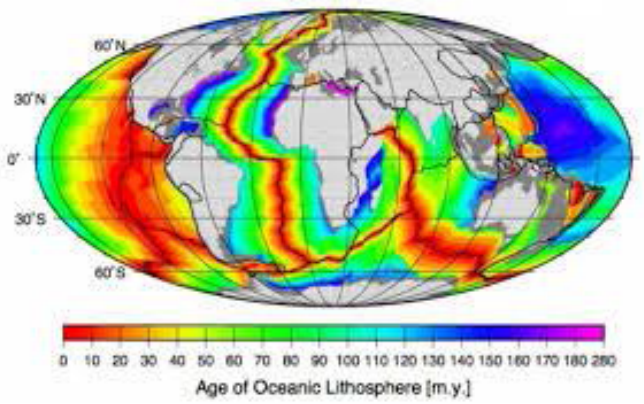

Figure 2:

Interestingly, there is also an ancient *Piri Reis* map (circa 1513) which is different from the map that we know today.

Figure 3:

C.2 Quantum Astrophysics

Provided the above interpretation of quantization of planetary orbit distances can be accepted (based on assumption of Bohr-type quantization to improve Titius-Bode law), then we can deduce a number of interesting implications, which are discussed more fully in our forthcoming paper [5].

Although it is known that "One of the cornerstones of inflationary cosmology is that primordial density fluctuations have a quantum mechanical origin," as Kanno & Soda wrote, however, most physicists consider that such *quantum mechanical effects disappear in CMB data due to decoherence*. [13] At this point, we can ask: Is that really so?

We have discussed before that cosmological entanglement has been observed, which in turn it can be attributed to superfluid turbulent interstellar medium.

Now, there is a recent striking report by Charlotte Olsen et al., suggesting that 36 galaxies seem to have "coordinated" in a such way that they appear to give synchronized stars formation. From Olsen et al.'s paper, they don't give a possible theoretical explanation. [14]

However, by hypothesizing that a spin supercurrent mechanism can happen at galactic scale because of superfluid interstellar medium, we

can come up with a plausible explanation; that such a coherent star formation is due to some kind of "galactic synchronicity."

We are aware that such a term is not available yet in present cosmological vocabularies, but we can foresee that time for that term will come too, as there is also a book, suggesting that synchronicity is likely to appear universally in the Universe; just like in our ordinary life, we sometimes meet an old friend without arrangement - and such an event can be viewed as Divine Synchronicity (cf.C. Jung). [15]

In the meantime, while it can be shown that such a galactic synchronicity may be associated to *cosmological-scale entanglement*, it remains to be seen if we need to modify macrodescription of electromagnetic phenomena towards cosmic electromagnetic theories. See for instance: Hoyle & Narlikar [17], and also Hannes Alfven [18].

A hetegony: plausible explanation for Pluto-Charon pairing

According to Stern et al.: "Given just two ingredientsthe state of the circle and the focal point of the power—"*Newton's Recipe*" permits one to figure the overall power at any orbital point. Pluto's uncommon orbit compared to the giant planets provoked different hypotheses about its beginning and provenance from the1930s to the1990s. ... Most famously Kuiper (1951) suggesting Pluto was the harbinger of a huge "trans- Neptunian" population of comets and larger bodies. ... This drove to a number of telescopic searches for that cohort populace" which was finally detected by the discovery of the primary Kuiper Belt (KB) Object (Jewitt & Luu, 1993). See S.A. Stern et al. [19].

There are extensive studies on Pluto-Charon pair system, see for instance [19-22]. For example, it is known that there are a number of satellites orbiting such a binary system, as Showalter and Hamilton wrote: "*Four small moons–Styx, Nix, Kerberos and Hydra*–follow near-circular, near-equatorial orbits around the central "*binary planet*" comprising Pluto and its large moon, Charon. New observational details of the system have emerged following the discoveries of Kerberos

and Styx. Styx, Nix and Hydra are tied together by a threebody resonance, which is reminiscent of the Laplace resonance linking Jupiter's moons: Io, Europa and Ganymede."[21]

Regarding the origin of Pluto-Charon binary system, there is a suggestion of giant collision.[22] While such a possibility may not be excluded, we argue in a previous published paper, that there could be a far more interesting possible explanation, provided we accept the aforementioned quantum explanation of orbital distances, that the Pluto-Charon pairing is an indicator of "*planetary equivalent*" to Cooper pairing in the outer solar system. As we wrote: "Pairing of Pluto-Charon and other TNOs/KBOs seem to be attributed to the BCS/BdG pairing condition pointing to low temperature physics model of Solar System." [23]

Nonetheless, we admit that for now and may be until a few years later,conventional readers are likely to consider such a suggestion a bit weird. However, we are more than sure that given more data will be available in the coming years, our hypothesis of quantum astrophysics will be confirmed eventually. Let history be the judge.

Concluding Remarks

In this paper we review on how Kepler and Newton began their scientific explorations based on the available observation data at their time. In other words, that indicates *a data-driven modelling* approach, as discussed by Brunton et al.[2] (Or if we can speak in social science terms, shall we use "*grounded approach*" in physical sciences too?)

We also discuss that even in Newton era, there were some critics to his book, notably Richard Bentley's letter to Newton. Other problems and paradoxes are also known until now, including by Zwicky etc.

In the second section, we discuss that provided we accept such a data-driven approach, starting from Titius-Bode law may suggest a possibility of quantum explanation of planetary orbit distances, hence *a quantum astrophysics*.

Finally we make a few remarks on plausible implications, including to explain the Pluto-Charon pair system. Conventional explanation of their origin includes giant collision in the past. Nonetheless, there could be a far more interesting possible explanation, provided we accept the aforementioned quantum explanation of orbital distances, i.e. that the Pluto-Charon pairing is an indicator of "*planetary equivalent*" to Cooper pairing in the outer solar system.

To summarize, I believe that the proposed quantum astrophysics and quantum geophysics are more feasible and achievable, compared to quantum gravity which is so elusive goal despite decades of efforts (really sorry for so many PhD students devoting time for that topic); *especially with respect to evidence-based physics and evidence-based mathematics* principles that we argue elsewhere [25].

Nonetheless, we admit that for now and may be until a few years later, conventional readers are likely to consider such a suggestion a bit weird. However, we are more than sure that given more data will be available, our hypothesis of quantum astrophysics will be confirmed eventually. Let history be the judge.

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Dialogue Between Two Chief Worldview Systems on Quantized Orbit Distances as Astrophysics Phenomena

Victor Christianto[1*]

Author's Affiliations:
Victor Christianto,
[1]Malang Institute of Agriculture (IPM),
Jl. Soekarno-Hatta, Indonesia.
*Initiator, Halton Arp Institute, with affiliation to International Mariinskaya Academy, St. Petersburg.

Corresponding author:
Victor Christianto, Malang Institute of Agriculture (IPM),
Jl. Soekarno-Hatta, Indonesia
E-mail: victorchristianto@gmail.com
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Abstract

This is a follow-up to our previous paper, suggesting going toward quantum geophysics and quantum astrophysics. Recently, a colleague asks to this author: "1. What is the quantum interpretation of the astrophysics? 2. What is the quantum explanation of the orbital distances?" This review paper will discuss two chief worldview systems on such quantized orbitdistances as a phenomenon in astrophysics and astronomy. We will discuss in specific way: scale relativity approach of Prof. Laurent Nottale, in comparison with our own approach. This short review is also intended as a response to M. Pitkanen's recent article. We hope this discussion will be found interesting.

Keywords: Planetary orbits, macroquantization, quantized orbits, low temperature physics, Nottale

Introduction

From time to time, cosmology and astronomy disclosures have opened our eyes that the universe is considerably more entangled than what it showed up in 100-200 years earlier. Additionally, thinking about old-fashioned Greek philosophers' speculations, for instance, *hydor model* (Thales) and *streaming fluid* model (Heracleitus). Historians told us that Thales was able to predict eclipse at May 28th, 585 BCE. It seems, by all accounts, to be at this point we are able to inquire: does it suggest that the Ultimate theory that we endeavor to find should follow with hydrodynamicsmodeling approach?[7]

In this context, in a recent paper, we discuss a data-driven approach to astrophysics, while arguing in favor of going toward quantum geophysics and quantum astrophysics [21]. Recently, a colleague asks:

1) What is the quantum interpretation of the astrophysics?
2) What is the quantum explanation of the orbital distances?

7 M. Pitkanen. Three Alternative Generalizations of Nottale's Hypothesis in theTGD framework. Prespacetime Journal, June 2021, Volume 12, Issue 2.

Therefore, this short review paper will discuss two chief worldview systems on such quantized orbit distances as a phenomenon in astrophysics and astronomy, in response to aforementioned questions.

We will discuss in a more specific way: scale relativity approach of Laurent Nottale, Schumacher *et al*. in comparison to our own approach, based on correspondence between low temperature physics and cosmology.

The title above is an adaptation to Galilei's book: *Dialogue concerning two chief world systems*.[8] Nonetheless, it does not mean that this author compares his cosmological model with such a figure like Galilei; instead he just thinksthat the discussions on which interpretation to choose for applying quantum mechanical principles to astrophysical phenomena, reminds us to that classic book in astronomy.

We hope this discussion will be found interesting for new readers.

Summary of Nottale's Ideas

From what we read from Nottale et al.'s [15] papers since 1996 and on, he started with scale relativistic argument, then deriving generalized Schrodinger equation for astrophysics bodies, for fractal spacetime case. His approach is something like Edward Nelson's procedure to derive Schrodinger equation from Newton gravitation equation (it is sometimes dubbed as "*Nelson's mechanics*").[9]

The complicated procedures that Nottale proposed, in the end boil down to a quantized radius equation for planetary orbit distances, as follows:

8 G. Galilei. Url: https://rauterberg.employee.id.tue.nl/lecturenotes/DDM110%20CAS/Galilei-1632% 20Dialogue% 20Concerning% 20the% 20Two% 20Chief%20World%20Systems.pdf

9 One of these authors once wrote a messsage to Prof. Edward Nelson the late, asking a few questions, just before he passed away.

$$r = \frac{n^2 GM}{v_0^2}, \tag{1}$$

where r,n,G,M,v_0 represent orbit radii (semimajor axes), quantum number (n=1,2,3,...), Newton gravitation constant, mass of the nucleus of orbit, and specific velocity, respectively.

One thing to point out here is that Nottale *et al*.[15] keep intact the standard probability interpretation of quantum wave function, *a la* Max Born. As far as this author know, even to Nottale's more recent publications, such a probabilistic interpretation prevents him to predict new planetary orbit beyond Pluto.[10]

That is where we started our new arguments.

An Early Endeavor to Rederive Nottale's Quantized Radii Recipe

It all began with a Santa Fe book, edited by Prof. W. Zurek, with title: *Entropy, Complexity and the Physics of Information* (Addison-Wesley Publ., 1990), that I obtained in a book sale in Jakarta around 1995 or 1996. Around the end of 1997, he found an interesting summary of article by Laurent Nottale-Schumacher from Observatoire de Paris-Meudon, describing their finding that Schroedinger equation can be generalized to *large scale astrophysics systems*. Therefore, around 1999-2000, I tried to find a simpler derivation of Nottale's equation to derive quantizated orbit distances of planetary systems, both in our solar system and also for exoplanets. At the time, he only got a few books, including that Santa Fe book (to abbreviate: WHZ).

10 Interested readers may wish to read Nottale's two recent books: [22][23]. And I should say here, by comparing our result here is meant to be a dialogue, and personally I am deeply grateful to Nottale's effort to describe all things in Nature using his approach of scale relativity, despite I prefer a bit more topological/superfluid low temperature approach to astrophysics.

After some time, he wrote a draft with title: "How much does information weigh?", which he published online in a personal website at early 2000. But unfortunately that piece of article has been vanished in the air.[11]

Summary of Cantorian Superfluid Cosmology

In this section, allow us to tell a story of our next phase of encountering with macroquantum condensate astrophysics. It began by a somewhat "educated guess" (or some readers may call it: *einfuhlung*), when he picked up an old book by Nozieres & Pines (1994), on superfluid Bose liquid.[18] Then he asked: Let us see what this book can bring to the realm of astrophysics and cosmology. Soon, he found many interesting findings in the literature, from W.H. Zurek to Grigory Volovik etc.

Shortly speaking, that is a beginning of our continued investigations in the past 16-17 years until now, resulting several papers in a series [3-10]. The earliest paper called "Cantorian superfluid vortex hypothesis" was published in July 2003 and January 2004, where he submitted a prediction of possible locations of 3 new orbits of planetoids in the outer side of Pluto. (Note: More observations until now have revealed more than 5 planetoids at the outer skirt of solar system, beyond Pluto orbit.)

Then two years later, he published a paper in AFLB [4], where he outlined what are possible explanations of macroquantum effects in astrophysics (such as observed also by Tifft and also Virginia Trimble etc. -- the socalled Tifft's redshift quantization). One of the arguments outlined in that AFLB paper is *macroquantum condensate*, i.e. possible quantum effect induced by BEC or superfluid-type medium.

More recently, he and other colleagues (VC, FS, YU) come up with an argument that observed *cosmological entanglement* may be caused

11 That early attempt to rederive Nottale's model of generalized Schrodinger was made during spare time, at the time he worked near Borneo island.

by such a macroquantum effect is real (CTPNP Conf. Proceedings, organized by Malang State University, 2019).

Discussion: Essential Differences Between Nottale's Scale Relativity and Csv Model

As we remark in previous section, it is worthy to note: One thing to point out here is that Nottale *et al*. keep intact the standard probabilistic interpretation of quantum wave function, a la Max Born. We don't check yet Nottale's more recent publications, but as far as I know, such a probabilistic interpretation prevents him to predict new planetary orbits beyond Pluto. (It can be mentioned here that until 2002, almost all textbooks on solar system tell us that Pluto is the farthest planet in solar system.)

As far as we know, probabilistic interpretation of quantum wave function is very problematic, and it was rejected by developer of wave mechanics, E. Schrodinger. See for instance, a rather popular book, John Gribbin: "*Schrodinger's kittens: In search of reality*". That is a quite interesting book to start with, if some readers want to know why reality is an elusive dream when it comes to deciphering the physical meaning of wave function in wave mechanics.[12]

And if some readers wish to read a more dense philosophical musing on probable relation between confusions of the *psyche* caused by such an elusive reality in QM and its connection with possible causation of WW II, you can read one or two articles of Derek Dillon's *Moon of Hoa Binh* papers, where he argues against the pedantic Born's interpretation of such a wave function.

In our first submitted paper on Cantorian superfluid cosmology model, I had a quite long discussion over the meaning of Nottale's method and also meaning of wave function in QM. The reviewer was the late Prof. Robert M. Kiehn from University of Houston. VC's early

12 John R. Gribbin. Url: https://www.publishersweekly.com/978-0-316-32838-8

draft actually tried to derive Nottale's quantized radius equation from a quite similar gravitational-Schrodinger equation, but with different assertion to meaning of wave function. In this interpretation, I wrote that the wave function in QM should be interpreted as "tendency to make structures." And Prof. Kiehn agreed with that interpretation, partly because it allows more substantial attribution, rather than abstract probabilistic argument of Born. (Prof/ Kiehn also wrote elsewhere on mathematical correspondence between 2D Schrodinger equation and Navier-Stokes equation.)

Nonetheless, the late Prof. Kiehn later on suggested a simpler and more elegant approach, i.e. in order to argue in favor of Old QM theory of Bohr to interpret quantization of planetary orbit distances and improving Titius-Bode Law.

The essence of derivation based on Bohr-type arguments, after some improvements, is as follows:[13]

Here we present Bohr-Sommerfeld quantization rules for planetary orbit distances, which result in a good quantitative description of planetary orbit distance in the Solar System.

First of all, let us point out some motivations for utilization of Bohr-Sommerfeld quantization rules: (a) the neat correspondence between Bohr-Sommerfeld quantization rules and topological quantization as found in superfluidity, and (b) there is neat correspondence between Bogoliubov-de Gennes and generalized Bohr-Sommerfeld quantization; in turn it can be applied to large scale systems like Solar system.

13 The aformentioned arguments based on Bohr-type quantization instead of complicated gravitational-Schrodinger equation, has been presented in SMIC conference, 2020, and it has been published in AIP Proceeding Series, 2021. See : Yunita Umniyati, Victor Christianto, Florentin Smarandache. An explanation of Sedna orbit from condensed matter or superconductor model of the solar system: A new perspective of TNOs. AIP Conference Proceedings 2331, 030014 (2021); https://doi.org/10.1063/5.0041656

Sonin's preface in his book can be paraphrased as follows:

> "The movement of vortices has been a region of study for over a century. During the old style time of vortex elements, from the late 1800s, many fascinating properties of vortices were found, starting with the outstanding Kelvin waves engendering along a disconnected vortex line (Thompson, 1880). … The circumstance changed after crafted by Onsager (1949) and Feynman (1955) who uncovered that turning superfluids are strung by a variety of vortex lines with quantized dissemination. With this revelation, the quantum time of vortex elements started."

The quantization of circulation for non=relativistic superfluid is given by [3]:

$$\oint v dr = N \frac{\hbar}{m_s} \tag{1}$$

Where, $N,\hbar,m_s$ represent winding number, reduced Planck constant, and superfluid particle's mass, respectively. And the total number of vortices is given by:

$$N = \frac{\omega\, 2\pi r^2 m}{\hbar} \tag{2}$$

And based on the above equation (2), Sivaram & Arun [16] are able to give an estimate of the number of galaxies in the universe, along with an estimate of the number stars in a galaxy. However, they do not give explanation between the quantization of circulation and the quantization of angular momentum. According to Fischer [17], the quantization of angular momentum is a relativistic extension of quantization of circulation, and therefore it yields Bohr-Sommerfeld quantization rules.

Furthermore, it was suggested that Bohr-Sommerfeld quantization rules can yield an explanation of planetary orbit distances of the Solar system and exoplanets [1-15]. Here, we begin with Bohr-Sommerfeld's conjecture of quantization of angular momentum. As we know, for the wavefunction to be well defined and unique, the momenta must satisfy Bohr-Sommerfeld's quantization condition:

$$\oint_{\Gamma} p dx = 2\pi n\hbar, \tag{3}$$

for any closed classical orbit Γ. For the free particle of unit mass on the unit sphere the left-hand side is:

$$\int_0^T v^2 d\tau = \omega^2 T = 2\pi\omega, \tag{4}$$

where, $T = \frac{2\pi}{\omega}$ is the period of the orbit. Hence the quantization rule amounts to quantization of the rotation frequency (the angular momentum) $\omega = n\hbar$. Then we can write the force balance relation of Newton's equation of motion:

$$\frac{GMm}{r^2} = \frac{mv^2}{r}. \tag{5}$$

Using Bohr-Sommerfeld's hypothesis of quantization of angular momentum (4), a new constant *g* was introduced:

$$mvr = \frac{ng}{2\pi}. \tag{6}$$

Just like in the elementary Bohr theory (just before Schrodinger), this pair of equations yields known simple solution for the orbit radius for any quantum number of the form:

$$r = \frac{n^2 g^2}{4\pi^2 GMm^2}, \tag{7a}$$

or

$$r = \frac{n^2 GM}{v_0^2}, \tag{7b}$$

where *r, n, G, M,* v_0 represent orbit radii (semimajor axes), quantum number (n=1,2,3,...), Newton gravitation constant, mass of the nucleus of orbit, and specific velocity, respectively. In equation (7b), we denote:

$$v_0 = \frac{2\pi}{g} GMm. \tag{8}$$

The value of *m, g* in equation (8) are adjustable parameters.

Interestingly, we can remark here that equation (7b) is *exactly the same* with what is obtained by Nottale using his Schrodinger-Newton formula [16]. Therefore here we can verify that the result is the same, either one uses Bohr-Sommerfeld's quantization rules of Schrodinger-Newton equation. The applicability of equation (7b) includes that one can predict new exoplanets (i.e., extrasolar planets) with remarkable result.

Therefore, one can find a neat correspondence between Bohr-Sommerfeld's quantization rules and motion of quantized vortices in condensed-matter systems, especially in superfluid helium [1,21]. Here we propose a conjecture that superfluid vortices quantization rules also provide a good description for macro objects such as in cosmology (cf. G. Voloovik) and also for planetary orbits in our Solar System.

Correspondingly, an idea that the chemistry composition of Jovian planets are different from inner planets began around 15 years ago, which suggests that it is likely both series of planets have different origin. By assuming inner planets orbits have different quantum number from Jovian planets, here by using "*least square difference*" method in order to seek the most optimal straight line for Jovian planets orbits in a different quantum number; then it came out that such a straight line can only be modeled if we assume that the Jovian planets were originated from a *binary star system: the Sun and its companion*, using the notion of $\mu = \frac{m_1 m_2}{m_c}$ as the reduced mass. Although based on statistical optimization [21,22], it yields new prediction of possible orbits of 3 planetoids in the outer skirt beyond Pluto, from which prediction, Sedna was discovered later by Mike Brown *et al*. (2004).

Some Implications to Cosmology Modeling

After some years, in a recent paper we began to draw implications of such a Bohr-type gravitational superfluid explanation of planetary orbit distances to cosmology. In essence, instead of agreeing with

asymmetric cosmology as we are taught in standard cosmology model, we would prefer a symmetric cosmology, by allowing negative masses at large scale to exist.

In the previously mentioned segments [19], we set forth a contention for low temperature physics model of nearby planetary group, specifically utilizing Bogoliubov-de Gennes conditions which are typically used for superconductors.

While this makes the model somewhat less difficult and understandable, one may ask: what are different confirmations accessible to legitimize the BdG model for the Solar system framework? In this respect, let us submit three supporting confirmations which appear to compare to the calculated result as we illustrated previously:[19]

* Pairing of Pluto-Charon and other TNOs/KBOs seem to be attributable to the BCS/BdG pairing condition;

** pointing to low temperature physics model of Solar System;

*** Solar interior has superfluid inner structure (Oliver K. Manuel et al.); see for instance [19-20].

Moreover, with regards to hypothesized twin partner of the Sun (that we call NMS = negative mass star), some literatures also argue that G1.9 is a remnant of supernovae, but others argue that G1.9 cannot be supernovae; instead it is more plausible to argue that G1.9 is *a brown dwarf star*.

Now, we refer to paper by Boney and also by Heald, who argue that

(a) Dirac-Feynman-Stueckelberg's interpretation of Dirac equation symmetry as requiring that antimatter is just an ordinary matter going backward in time, that is not the only possibility.

Quote from Heald:

"If rest mass energy is not a real scalar quantity buta potential imaginary energy, then the rest mass of antimatter will have negative potential energy. Accordingly, it would follow that the total relativistic energy of a matter or

antimatter particle can be described by a complex vector summing the real kinetic and imaginary rest mass energies and Newton's law of gravitation will remain valid for antimatter. Theorems of quantum physics and general relativity have shown that antimatter has negative gravitational mass, and so matter and antimatter bodies will exert mutual gravitational repulsion.[20]"

Boney also suggests that it is also equally possible to interpret antimatter as having negative mass. He wrote: "Unfortunately, it seems there is no imperative to imagine antimatter moves backwards in time, at least from the Dirac equation, if you allow negative mass solutions. [20]" The notion of negative mass is admittedly quite strange and counter-intuitive for solar physics or cosmology, but it is well accepted in solid state physics and condensed matter physics. Similarly, H. Choi & P. Rudra argue in favor of pair creation originated from positive-negative energy [28].

(b) Meanwhile, Anastopoulos-Hu argue that Newton-Schrodinger equation which is quite common in somemodels for AQT (alternative quantum theory), especially for macroquantumphysics, is quite problematic [20].

To summarize, provided argument (a) and (b) above can be accepted, then we suggest to consider symmetry between ordinary matter and antimatter (negative masses) should be considered from the beginning of physical modelling. With regards to experimental vindications of such a negative mass particle, allow us to refer to: (a) M.A. Khamehchi et al reported finding on Negative mass hydrodynamics in a spin-orbit–coupled Bose-Einstein condensate [26], and (b) Kai-Qiang Lin et al. published their experimental finding on negative mass particle, *Nature Communications* [27].

As such, that is why we consider Bogoliubov-De Gennes equations instead of Newton-Schrodinger equation, i.e. BdG equations are essentially coupled Schrodinger equations, reflecting those pairs of particles. In addition, we may also consider symmetric Dirac-Milne cosmology model, which is essentially a generalized Newtonian

cosmology which admits negative gravitational mass. There are growing interests to Dirac-Milne model in recent years. [20]

This appears to support our suggestion of conceivable twofold buddy of the Sun as negative mass star (NMS) as we considered in a prior paper [1]. Similarly, as with expected area to discover the bantam friend of the Sun, we can specify here that since 2017, there is an article named as Gliesse G1.9 which was seen around 60-66 AU (around Pluto/Kuiper Belt). In this manner it very well may be a decent begin to see if the G1.9 is surely the binary partner of the Sun that we're searching for [19].

Moreover, further investigations are needed to extend Dirac Milne model towards symmetric *Quantum Liquid Dirac Milne* (QLDM), implicated by our superfluid dynamics model.

Concluding Remarks

In this review article, we discuss several essential differences between Nottale *et al.'s* [15] interpretation and approach to derive generalized gravitational Schrodinger equation, in order to explain planetary orbit distances, and our approach which was based more on phenomenological approach of superluidity dynamics as observed in lab.

In essence, it is worthy to note that Nottale *et al.* [15] keep intact the standard probabilistic interpretation of quantum wave function, *a la* Max Born. As far as I am aware of, up to Nottale's more recent publications, his approach based on such a probabilistic interpretation of wave function, prevents him to predict new planetary orbit beyond Pluto.

As far as we know, probabilistic interpretation of quantum wave function is very problematic, and it was rejected by developer of wave mechanics, E. Schrodinger (see his famous remark around 1955, while he was in Dublin/DIAS).

On the contrary, our approach to quantized orbit distances as astrophysics phenomena was based on superluid quantization known in low temperature physics, by assuming that superfluid vortices quantization is equivalent to Bohr-type quantization.

We hope that this review paper would be found useful in suggesting that time has come to consider "quantum astrophysics," especially considering such quantization of planetary orbit distances. See our other paper in this journal [21].

Acknowledgement

This author wishes to thank to many physicist and scientist fellows for discussions and insights, especially Prof. Florentin Smarandache and Robert Neil Boyd. Interested readers may wish to read Nottale's two recent books: [22][23]. And I should say here, by comparing our results here is meant to be a dialogue, and personally I am deeply grateful to Prof. L. Nottale's effort to describe all things in Nature using his approach of scale relativity, despite I prefer a bit more topological/ superfluid low temperature physics approach to astrophysics and cosmology. His approach to generalize Schrodinger equation to macro scale objects did much to motivate me to enter this quantum astrophysics study over all these years.

This author also wishes to extend sincere gratitude to numerous physicists who have discussed this theme of macroquantization and related issues, including: the late R.M. Kiehn, the late Antun Rubcic(Zagreb Univ.), Pavel Pintr, Carlos Castro Perelman (Clark Atalanta Univ.), Slobodan Nedic (Serbia), Sergey Ershkov, Yunita Umniyati, Arno Gorgels, and others. I am also really grateful for insights of Prof. The Houw Liong for suggesting to look at Jayant Narlikar's paperson VMH. And special thanks goes to Eny Latifah (Chair of Conference, CTPNP, 2019, held at Universitas Negeri Malang, Indonesia) and also Mutia Delina (Chair of Conference,

SMIC, 2020, held at Universitas Negeri Jakarta, Indonesia). However, this paper is our sole responsibility.

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Version 1.1: 10thAug. 2021, pk. 9:19
Version 1.2: 23rd Nov. 2021, pk. 19:30
VC

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B

4 Papers on using balanced brain (intuilytics), a new quantum communication, and proving the existence of God (starting from Godel and Pavel Florensky's argument)

Cronicon OPEN ACCESS EC NEUROLOGY
Short Communication

How to Balance Intuitive and Analytical Functions of Brain: A Neutrosophic Way of Scientific Discovery Process

V Christianto[1*], RN Boyd[2], and F Smarandache[3]

[1]Satyabhakti Advanced School of Theology - Jakarta Chapter, Indonesia
[2]Consulting Physicist for Princeton Biotechnology Corporation, Department Information Physics Research, USA
[3]Department of Mathematical Sciences, University of New Mexico, Gallup, USA

*Corresponding Author:
V Christianto, Satyabhakti Advanced School of Theology - Jakarta Chapter, Indonesia.
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Introduction

Initially this article stems from our discussion on math and mysticism, inspired by an article by Ralph Abraham [1]. But it becomes a discussion on the role of intuition and inspiration in scientific discovery process.

Hopefully this article will help anyone who aspires to be good scientists or engineers.

Logic and Experience

Logic and mystical experiences are exclusive domains that cross over into one another, on occasion, just as everything else does as participants in Experiences of the Wholeness, Harmony, Balance, Caring, and Oneness of the Alive Aware Intelligent Conscious Universe. All of this partly constitutes the *Mind of God*, which is vaster and more complex than most human beings are able to even vaguely comprehend.

For example, from the basis of Bhutatmas, the tiny Consciousness-experiencing creatures that have vast experiential memories, that Everything, all fields, all forces, all matter, all life, and the entire of the Infinite Cosmos, results from the activities and agglomerations of Bhutatmas, in an Infinite Universe constructed and operated by Intelligent Design.

According to the Vedic literature on this topic, Divinity resides in the Actually Infinitely Small, which is everywhere and nowhere, at the same time. Thus, it can and does act on everything that is and everything that happens. But Divinity has set things up so that Everything has Free Will and individual volition. A factor that has been left out of the Vedic literature on the topic of Bhutatmas, is that every Bhutatma is Unique, with a unique set of memories of experiences, regarding multiple Realities (not just this one). So, Uniqueness is an absolute in all the realms, and all the Realities.

Logic and Experience are mutually exclusive. If you are involved in logic, you are not able to have full and deep experiences of the senses and sensitivities, at the same time.

So, there is the Nature World operating in Divine Harmony, and the "people world", which made from analytical thought. Analytical thought separates the human being from being able to directly Experience the Cosmic Harmony, personally. However, Nature is constructed, and operates such that human beings can go beyond thought and into Direct Experience of the Cosmic Harmony and the Natural Harmony.

We hope that by now, the readers have arrived at some cognizant awareness of the differences between analytic thought and experiential thought; between the Nature and Divine Ways, and foolish people ways which are based in behavioral ignorance of the All and constrained by thought-originated pains and struggles, which result from the "ego", which is a product of analytical thought.

Direct experience, inner vision and experiencing God

More "right brain" activity, based on direct experiences, leads to direct experiences of the Divine. Your "inner vision" (the "mind's eye") can help readers in this, and in many other ways.

The inner vision is also the seat of many of the intuitive faculties, which are experiencable facts, not imaginings. That means the information obtained by the intuitive faculty is verifiable and reproducibly observable.

In order to do that, the Balanced Brain is the most efficacious way to function, as well as the most efficient, and the most comfortable.

To obtain the Balanced Brain, the person usually needs to spend a great deal of their spare time being receptive, being the "receiver", being accepting and exploring, and not using the analytical intellect, but instead, spending time in the Now and in the Senses and Sensitivities. This is best enjoyed in Natural settings.

For instance, one of us (RNB) spent one to three hours each day in the Forest in the Experiential State, exploring how Nature works, every day for 17 years. Somewhere in those years, he arrived into Transcendent States and Natural Awarenesses.

Not many people know what the Natural Man is like, because they've never experienced it. And they've never seen one. The Natural

Man is removed from all varieties of intellectual indoctrinations and pain-producing ego-based behaviors.

Lao Tzu calls this condition "An uncarved section of wood", partly because it is an arrival at the Original State. (How we were when we first came here, before all the indoctrinations and traumas started removing us from being who we were when we first came here).

In relation with discovery process, one of us (RNB) distinguishes discovery, soft vision from merging vision. Those three types of vision are based on Native American Spiritual Practice. For more explanation on these, see RNB's article on penetrating insight [8].

The Role of Intuition and Logic in Scientific Discovery Process

Logical analysis is best used when following after an intuition or an "instinct". An instinct is almost infallible. And once you have trained your mind to be attentive to their experience and sense, and they keep an open mind, then many ways of innovations will open their own ways to their mind.

All people got a lot of natural ability and learned skills, so it should be fairly easy for them to start tracking things down.

This is just the same thing, only better, because it's about Discovering things and being Creative.

So, now we come to this conclusion: intuition leads to insights and this is actually the source of true discovery like Tesla etc. Logical analytic can pursue where the intuition leads them, but not the other way around.

In this train of thought, we can also learn from Neutrosophic Logic as discovered by one of us (FS), which emphasizes that there are middle ways, or dynamics of opposites and neutralities in everything we observe [9]. Similarly, in order to condense our discussion on the role of intuition and analysis in scientific discovery, let us emphasize that intuition and insight should come first then logical analysis can follow through to see what can be done with that intuition. We prefer to call it "intuilytics" process. That is: analytic work inspired by intuitions. Although, at first glance it looks difficult, it would be more smooth if we follow this path, not the other way around (intuition follows logical-analysis).

In the following section, we will discuss two examples of scientific discovery processes, which hopefully will emphasize our points as mentioned above.

Two examples of scientific discovery process

Learning from Henri Vidal

Let us discuss a novel concept in engineering, called: earth stabilization using Reinforced Earth. Sometimes, earth reinforcement is also called mechanically stabilized earth (MSE) [2].

Using straw, sticks, and branches to reinforce adobe bricks and mud dwellings has happened since the earliest part of human history, and around 1960s French engineer Sir Henri Vidal invented the modern form of MSE, he termed Terre Armee (reinforced earth). In his submission for his patents he covered every possible reinforcement and facing type. Reinforcing levees with branches has been done in China for at least a thousand years, and other reinforcements have been universally used to prevent soil erosion.

Modern use of soil reinforcing for retaining wall construction was pioneered by French architect and engineer Henri Vidal in the 1960s. The first MSE wall in the United States was built in 1971 on

State Route 39 near Los Angeles. It is estimated that since 1997, approximately 23,000 MSE walls have been constructed in the world.

How the idea of Reinforced Earth came? It all began like a game, when Henri Vidal, a French highway engineer and architect, was trying to build a sandcastle on the beach. But the sand kept on falling off and this led to the idea of reinforcing the construction with pine needles. That is how the general principle of Reinforced Earth. From that experience, he went on and wrote his dissertation on La Terre Armee [3].

Here we see an example how a direct experience (playing with sand castles) gave an intuition which then leads to a scientific discovery.

Although usually, the materials used in reinforcing earth are metal, plastics or other man-made materials, we can use natural-made materials such as bamboo, which is commonly available in many villages in Asia or other tropical countries.

However, studies on bamboo-earth reinforcement is pretty scarce [4,5].

Learning from Monozukuri

Perhaps you've heard of the Japanese word monozukuri (sometimes written as 物作り, but most often written as ものづくり). Literally translated, it means to make (zukuri) things (mono). Yet, there is so much meaning lost in translation. A better translation would be "manufacturing; *craftsmanship; or making things by hand*". However, this translation also does not give justice to the weight and influence this idea has in Japan.

The word itself is quite old and considered to be an original Japanese (i.e., not Chinese or Western-origin) word. Historically, it was used in connection with an individual artisan and craftsman who took pride in his or her products.

You probably know of famous artists like Shakespeare, Michelangelo, Picasso, Kahlo, and many more. Now do you know a famous potter? No? How about a famous smith? A carpenter? How about a weaver? We'd surprised if you do. We didn't.

Japan also has its share of famous Japanese artists. Many of them are officially recognized as Living National Treasures (人間国宝 Ningen Kokuhō) of Japan. They include performing artists like musicians, dancers, and actors in traditional Japanese arts.

Yet another subtle way in which the Japanese express their value for work is in their greetings. At the end of the workday when the workers leave the factory, office, or general workplace, the custom greeting to the departing colleague is *gokurosama* (ご苦労さま), meaning thank you for your effort.

Yet, digging deeper into the Japanese character, this greeting implies more than just effort, directly connecting to hard and physical labor. The first kanji 苦 stands for pain, trouble, difficulty, hardship; and the second kanji 労 stands for labor, toil, work, effort. Overall, this common message thanks the departing colleague for his hard and demanding physical work, even if the person is only an office worker. This is another example in how the value of physical work is deeply ingrained into the Japanese society.

A spin-off of *monozukuri* is *hitozukuri* (人作り, making people) for developing people. This includes the lifelong education, training, and coaching of people, not only in the classroom but especially at work.

At Nissan they are also *kotozukuri* (事作り, making stories) for "brand storytelling," with the goal of entering into "*dialogue with the customer*." However, this is little used outside of Nissan.

To summarize, the Monozukuri concept embraces more than the literal meaning. It offers the idea of possessing the "*spirit to produce excellent products and the ability to constantly improve a production system and process*". The concept carries "overtones of excellence, skill, spirit,

zest, and pride in the ability to make things good things very well. Monozukuri is not mindless repetition; it requires creative minds and is often related to craftsmanship which can be earned through lengthy apprenticeship practice rather than the structured course curricula taught at traditional schools." In that sense, Monozukuri is an art rather than science [7].

Again, you see that deep in Japanese original work ethics they put high value on direct experience in work and arts, in other words "handcrafting" gets a special value in Japanese culture.

That partly explains why Japanese people often came out with new products which were simply designed to accommodate a special niche, such as Walkman by Sony, which was designed for people who like to enjoy music while walking or doing aerobic in the street without having to disturb other people nearby.

Once again, direct experience and hand working can lead to so many types of inventions and also in scientific discoveries.

Concluding Remarks

What we intend to show in this article is that the distinction between the logic and experience is something related to analytics function of the left brain and intuitive-wholeness function of the right brain. We suppose the healthy way is to optimise both function of left and right brain.

And similarly, in order to experience God, we shall feel Him intuitively not rationally.

So, now we come to this conclusion: intuition leads to insights and this is actually the source of true discovery like Tesla etc. Logical analysis can pursue where the intuition leads them, but not the other way around.

Using Neutrosophic Logic, we propose a new term for this process: intuilytics.

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Eureka Moment as Divine Spark

Victor Christianto[1*] & Florentin Smarandache[2]

[1]Satyabhakti Advanced School of Theology,
Jakarta Chapter, Indonesia
[2]Dept. Math. & Sci., Univ. of New Mexico, Gallup, USA

*Correspondence:
Victor Christianto, Satyabhakti Advanced School of Theology,
Jakarta Chapter, Indonesia.
Email: victorchristianto@gmail.com

Abstract

In the ancient world, the Greeks believed that all great insights came from one of nine muses, divine sisters who brought inspiration to mere mortals. In the modern world, few people still believe in the muses, but we all still love to hear stories of sudden inspiration, like Newton and the apple, or Archimedes and the bathtub. We are eager to hear and to share stories about flashes of insight. In this article, we point out some arguments suggesting that the eureka moment is divine spark.

Keywords: Eureka, divine spark, insight, creativity.

Introduction

Burkus, an educator of the executives management science, investigates innovativeness back to antiquated Greek fantasies. He contended that in Greek folklore, purported innovativeness was just controlled by a bunch of individuals who were honored by the divine beings' sprinkling of the "*divine fire*", so they in some cases experienced Eureka minutes [1].

As indicated by Burkus, there is nothing of the sort as an imaginative flash or aha minute. Genuine imagination is an iterative procedure, regularly comprising of moderate and steady changes and advancements for existing thoughts. Imaginative people seldom create in disengagement; actually, bunches are greater at advancement than people. Large thoughts are not constantly perceived from the start; many need a very long time to acknowledge, and others simply vanish.

Burkus likewise dismisses the organization's endeavors to empower innovativeness, contending that there is little proof of such endeavors bringing about more advancement. Inventive individuals are propelled by the work itself, which they feel is expressly fulfilling; Extrinsic sparks assume a moderately little job in their lives. The appropriate response, he proposed, was just giving individuals the work they needed to do, which they discovered fulfilling. He also believes that a happy workplace and a good team spirit, which is generally believed to be beneficial for creative thinking, can actually act as a barrier. "Excessive focus on cohesion.... actually can reduce team creativity," he wrote. "This can narrow down choices and cause those who have a unique perspective to censor themselves rather than take risks not to be considered part of the team."

What is *Eureka* moment?

Eureka's minute feels like a blaze of understanding since it frequently leaves periods when the brain isn't centered around the issue, which

therapists call the hatching time frame. Brooding is where individuals step once again from their occupations. A significant number of the most beneficial innovative individuals purposely put aside activities and enjoy a physical reprieve from their work by accepting that this hatching stage is when thoughts start to blend beneath the limit of cognizant idea.

A few people shuffle different undertakings simultaneously under the conviction that while their cognizant psyche is centered around one anticipate, others are hatching their intuitive. The knowledge that emerges after hatching is the thing that feels like we are outfitting the intensity of delivering similar thoughts that help Newton and Archimedes [4].

An exploration group drove by Sophie Ellwood as of late discovered experimental proof for the intensity of hatching to upgrade imaginative understanding. The scientists isolated 90 undergrad brain research understudies into three gatherings. Each gathering is appointed to finish the Alternative Usage Test, which solicits members to make a rundown from the same number of uses of normal items as they can envision. Right now, were solicited to make a rundown from potential employments of paper. The quantity of unique thoughts delivered will fill in as an alternate proportion of thought, a significant component of imagination and a significant advance towards finding feasible bits of knowledge for Europeans.

The main gathering chipped away at the issue for 4 minutes persistently. The subsequent gathering was hindered following two minutes and approached to deliver equivalent words for each word from the rundown gave (considered another undertaking that did innovativeness), at that point given two additional minutes to finish the first test. The last gathering was hindered following two minutes, given the Myers-Briggs Type Indicator (thought about a random undertaking), and afterward requested to keep on taking a shot at the trial of utilizing the first option for an additional two minutes. Aside

from the gathering, every member was given a similar measure of time (4 minutes) to deal with a rundown of potential uses for a bit of paper.

The research team can then compare the creativity that results from ongoing work, work with the incubation period in which the related tasks are completed, and work with the incubation period in which the unrelated tasks are completed. Interestingly, the researchers found that the group that was given a break to work on an unrelated task (the Myers-Briggs test) produced the majority of ideas, an average of 9.8 [4]. Burkus in his HBR article states [4]:

> One possible explanation for these findings is that when presented with complicated problems, the mind can often get stuck, finding itself tracing back through certain pathways of thinking again and again. When you work on a problem continuously, you can become fixated on previous solutions. You will just keep thinking of the same uses for that piece of paper instead of finding new possibilities. Taking a break from the problem and focusing on something else entirely gives the mind some time to release its fixation on the same solutions and let the old pathways fade from memory. Then, when you return to the original problem, your mind is more open to new possibilities – eureka moments.

Discussions

That creative spark or Eureka moment is indeed rare is true. But it is also not always true that working in groups produces more ideas. Although Burkus's analysis is quite interesting, it seems that he is too influenced by the management's perspective on creativity. More references are needed about methods of generating ideas and also the literature of creativity experts such as De Bono [2-3].

In addition to the task switching method as a way of incubation described above, there are actually various ways to generate fresh ideas and insights, see for example [3]. One quite interesting way is to provide regular intake to our minds, for example every morning, with two words combined at random (random).

Around 2002-2003, one of these authors (VC) made a small script that basically: (a) uses the Miriam-Webster or Oxford dictionary as a data source, (b) randomly selects two nouns from the dictionary, (c) displays both words as new phrase to users. Imagine, for example, one morning while you were having coffee and breakfast, knowing on your cellphone screen a strange phrase appeared: "ice cat" ... Your mind must have been searching for what was the meaning or application of the phrase "cat ice"? Maybe it can be a beautiful ice sculpture in the form of a cat (usually at a large party event there is "*ice carving*"). And so on, we tend to be more creative if our minds are routinely consumed with fresh things, which can be raised by such a method, which may be termed: RWPG method (*random word-pair generator*).

Another way, which might be closer to the original meaning of the Eureka moment as "*divine spark*," is to use time deliberately to experience and communicate with God and nature. This method is closer to *experiential learning patterns*. For example, if you take an hour each morning to take a walk in the woods or in the fields, observe the things you find along the way. And also take time to pray and communicate with God. See our previous papers [5-6].

Conclusion

Like Newton and the apple, or Archimedes and the bathtub (both another type of myth), we are eager to hear and to share stories about flashes of insight. But what does it take to be actually creative? How to have such a flash insight? Turns out, there is real science behind "*aha moments*". This article is our way to distinguish which is actual activity and which is myth in order to get such flash moments.

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Review Article

A Harmless Wireless Quantum Alternative to Cell Phones Based on Quantum Noise

RN Boyd[1], V Christianto[2*] and F. Smarandache[3]

[1]Consulting Physicist for Princeton Biotechnology Corporation, Department Information Physics Research, USA
[2]Satyabhakti Advanced School of Theology-Jakarta Chapter, Indonesia
[3]Department of Mathematics and Statistics, University of New Mexico, Gallup, USA

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*Corresponding Author:
V. Christianto, Satyabhakti Advanced School of Theology-Jakarta Chapter, Indonesia.

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Abstract

One postulate known as Smarandache hypothesis says that there is no speed barrier of anything, including light and communication - interaction. In the meantime we know that 4G and 5G technologies cause many harms to human health. Therefore, here we submit a harmless wireless quantum alternative to cell phones[14]. It is our hope that this alternative communication method can find its way to realization, while the existing wireless RF technologies (4G, 5G) are being phased out.

Keywords: Harmless Wireless Quantum; Cell Phones; Quantum Noise

Introduction

So many physicists, from the youngest to the oldest, still think that the velocity limit of almost anything is speed of light (c). However, allow us to argue on 3 reasons why superluminal speed remains possible:

- The drift equation. It is often used in plasma experiment, saying that the speed becomes exceeding c if you put magnetic field as small as possible (thanks to RN. Boyd for noticing this fact)
- Aspect's experiment reveals that quantum entanglement is real [1]. While surely we can argue if such an entanglement can be explained by certain hidden variable theories or classical physics theories, one thing is certain that atomic entity can communi- cate instantaneously at a remote distance, just like what Newton wrote [2].
- Smarandache's hypothesis. One of us (FS) in 1972 proposed that as a consequence of the Einstein-Podolsky-Rosen paradox, there is no speed limit in the universe (i.e. the speed of light c is not a maximum at which information can be transmitted) and that arbitrary speeds of information or mass transfer can occur. Eric Weisstein from

14 This article is a sequel to previous paper: Christianto V, Boyd RN, Smarandache F (2019) Wireless Technologies (4G, 5G) Are Very Harm- ful to Human Health and Environment: A Preliminary Review. BAOJ Cancer Res Ther 5: 066. url: https://bioaccent.org/cancer-sciences/ cancer-sciences66.php

Encyclopedia of Physics wrote: "These as- sertions fly in the face of both theory and experiment, as they violate both Einstein's special theory of relativity and causality and lack any experimental support. It is true that modern experiments have demonstrated the existence of certain types of measur- able superluminal phenomena. However, none of these experiments are in conflict with causality or special relativity, since no information or physical object actually travels at speeds v > c to produce the observed phenomena" [3,4].

- Rodrigues and Lu argue for UPW or may be called X-wave, where both acoustic and electromagnetic wave, and even Klein- Gordon solution can lead to superluminal speed [5].

In this article, we describe basic principle of superluminal wave communication technology, i.e. quantum communication[15], as an alternati - ve to radio frequency based wireless communication technology.

Basic principles

This communication method can provide an infinite number of infinite bandwidth communications channels for each user. Communication using this - method travels much faster than light. It does not use radio waves and does not need wires. It cannot be monitored nor tracked nor interfered with. It cannot be regulated due to the infinities involved, and due to the fact that it is unmonitorable. Each user benefits personally from the perfect information security provided by quantum communications.

Quantum communication does not harm any form of life, nor the environment, in any way, as quantum events are, and always have been, constantly a part of the Natural Environment.

15 Research in quantum communication and possible realization have begun in the past few years, see for instance Max Planck Institut article: https://www.quantummaterials.mpg.de/10840/Quantum-communication

This method is not related to “Q-bits” nor “quantum teleportation” nor “quantum amplification” approaches, in any way. It is based on the Schrödinger equations of Quantum Mechanics. One of the features of the Schrödinger equations is a descriptive prediction of what is called “quantum noise”. This is the constant “hiss” that one hears when using an FM radio, and setting the frequency selector in between active broadcast channels. The sound is called “quantum noise”Quantum[16]. noise is observable at every location in the infinite volume universe.

Quantum noise is the result of non-local Subquantum processes which cause apparently random quantum behaviors in physical systems, particularly those which involve electric, magnetic, or electromagnetic fields.

The situation is described by the quantum observable A of the system.

In Nature we commonly observe a “continuous spectrum” of quantum activity[17]. This is partly described by the position operator quantum Q in mechanics. In the normal continuous spectrum case, the vector can be written as a complex-valued function in the spectrum of Q. For the expectation value of the position operator, one then has the formula.

A similar formula holds for the momentum operator P {displaystyle P}, in systems where momentum has continuous spectrum. When both P and Q operators are involved with thermodynamic systems and electromagnetic systems the situation is considered as a “mixed state”.

The situation is described by a positive trace-class operator which is known as the “statistical operator” or the “density matrix”.

This boils down to the fact that there is an expectation value in situations which involve quantum noise, which should normally appear as perfect randomity in the quantum system we are observing.

16 See for example: https://www.rp-photonics.com/quantum_noise.html

17 See for example: http://farside.ph.utexas.edu/teaching/qm/lectures/node18.html

Perfect randomity is called 3rd Order randomity and is completely unpredictable. 3rd Order randomity then represents the normal beha - vior of our quantum system as it interacts with Subquantum entities which are interacting with the system from up to infinity away and with up to an infinite velocity. 3rd Order randomity is the quantum expectation value of all Natural systems, in all locations and at all times.

There are ways to detect and predict quantum noise and the physical changes produced by quantum noise in quantum systems. (These methods will not be discussed at this time). When we detect the quantum noise, for example, in the form of "white noise" between radio stations, we expect the quantum spectrum centered on the channel of our receiver to exhibit 3rd Order randomity in both electromagnetic frequency and magnitude domains, in our selected channel.

However, environmental factors such as the presence of physical or non-physical forms of Consciousness can act on the 3rd Order randomity so as to bring predictability and order to the stream of random number which our E/M detector array passes on to our discriminat - or system.

Related to this, it was proved by instrumented experiments in the USA and in France during the 1990s that the Attention, Intentions, and Emotional State of operators of symplectic, complex, and standard electromagnetic transmission facilities, resulted in instantaneous changes in the radiation patterns of the transmission antennas, influencing the Q of the antennas and causing divergences in the quantum event potential in volume of the broadcast E/M radiations.

One of the results of these experiments was a series of experiments performed by Rodger Nelson., et al. at Princeton Engineering Anomalies Research, associated with Princeton University, which proved that consciousness, attention, intention, and emotional states, directly influence quantum systems, contrary to Bell's Theorem, thus proving that quantum physics is incomplete. This resulted in

refinements and de - velopments which eventually led to a Patent being approved by the PTO.

When the Patent was issued, further developments led to the Mindsong(TM) a computer-based hardware-software system that made the users computer telepathic, eliminating the need for computer data input peripherals such as mouse and keyboard. Mindsong was removed from the retail market by one or several of the 3 letter agencies of the US government and was subsequently only available for in-house use by operators of computers associated with those various agencies.

Mindsong was based on a programmable ASIC (Application Specific Integrated Circuit) made by AMD and programed by the Mindsong development engineering team. The ASIC[18] when coupled to the other parts of the Mindsong system, resulted in a plug-in card for the PC, and a software installation, which cause ones computer to become telepathic with the specific user, after a short training interval, similar to "speech-to-text" systems, only with no physical input devices required.

The Mindsong is not available. But there are many ways to accomplish any given goal, such as a "thought switched" telepathic comput - er. In this endeavor we have designed and tested a different way to obtain a telepathic computer, based on the Schrödinger equations of QM and "expectation values"[19].

Quantum Communication Basics

Quantum communications requires that we first establish, empirically, a 3rd Order random number sequence in the binary number stream which is produced by the Random Number Generator (RNG)[20] which precedes the parsing and data analysis which is performed by a Holographic

18 See https://www.electronics-notes.com/articles/electronic_components/programmable-logic/what-is-an-asic-application-specific-integrated-circuit.php

19 6See http://worlds-within-worlds.org/physicsofconsciousness.php

20 7See https://stattrek.com/statistics/random-number-generator.aspx

Artificial Intelligence (AI) software application. In this regard, the "TestU01" software library offers a collection of utilities for the empirical statistical testing of uniform random number generators [6].

When we have empirically proved that the number sequence from the RNG is 3rd Order random, at the quantum detector array output, we can turn on the Holographic AI software system and start parsing the incoming number sequence for deviations from 3rd Order randomity– Holographic Artificial Intelligence is a product of Advanced Neural Devices of Canada [7].

And Corporation's primary services are in the development of applications and products derived from Holographic Neural Technology (HNeT)[21].

HNeT is the only AI that is capable of accomplishing the unique identifications we need to extract from the random binary input number data stream which arrives to HNeT from the quantum detector array, after A/D conversions have been performed on the analog quantum input [8].

HNeT is capable of learning and recognizing patterns that are far beyond the abilities of human beings, in very small time frames. During the Training phase, HNeT interacts with the unique individual user and learns to recognize input information in the forms that particular user normally uses. HNeT then remembers those patterns, in the same way we learn a new language.

HNeT also provides the interface to the quantum information provided by SQ modulations of quantum systems by the Universe and by the user. This establishes a telepathic link between the user and the holographic AI, such that the user device can be operated without any requirement for a physical data input device.

After long-term interactions between the holographic AI and the user, it is possible that a bi-directional telepathic bond might be es-

21 http://www.andcorporation.com/

tablished between the user and the communications device which incorporates HNeT holographic AI.

Each user is unique and each device is also unique. Personal communications among users can be arrived at through personal in- troductions among various unique individuals, similar to what happens in daily interpersonal life when it does not involve cell phones, computers, and so on.

Broadcasts are also possible, which communications will only arrive to the set of beings whom have agreed to participate in the se- lected broadcast, similar to signing up for an internet subscription.

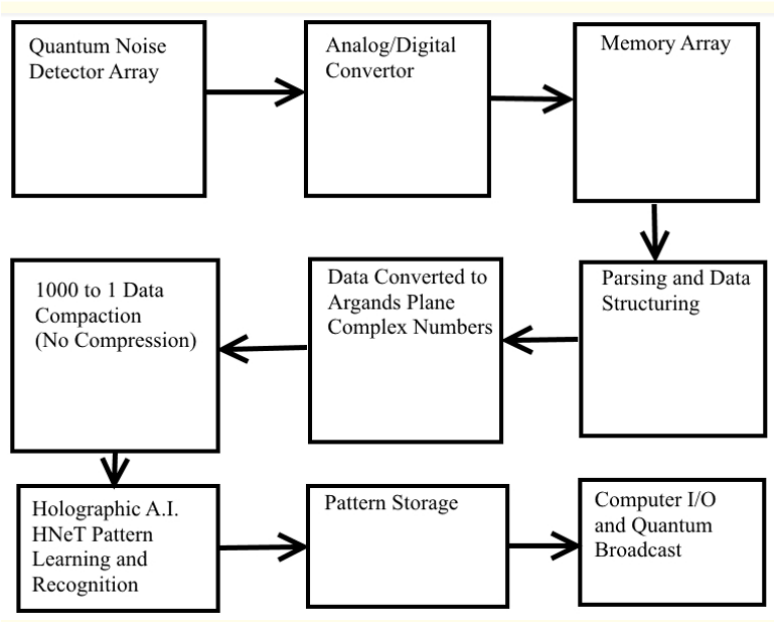

Figure 1: A block diagram of the process of quantum communication.

Concluding Remarks

One postulate known as Smarandache hypothesis says that there is no speed barrier of anything, including light and communication

interaction. In the meantime we know that 4G and 5G technologies cause many harms to human health.

In this article, we describe basic principles of superluminal wave communication technology, i.e. quantum communication, as a harmless alternative to RF based wireless communication technology. There are many advantages of quantum communication as proposed herein compared to the existing RF based wireless communication

It is our hope that this alternative communication method can find its way to realization, while the existing wireless RF technologies (4G, 5G) are being phased out. Nonetheless, the present technology as described herein is in conceptual development phase, more re- search can be expected in the near future.

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An Outline of New Proof of the Existence of God

Victor Christianto[1*] & Robert N. Boyd[2]

[1]Satyabhakti Advanced School of Theology - Jakarta Chapter, Indonesia
[2]Princeton Biotechnology Corp., Dept. Information Physics Research, USA

*Correspondence:
Victor Christianto, Independent Researcher.
Email: victorchristianto@gmail.com

Abstract

Starting with a few known arguments to prove the existence of God, we discuss our arguments, *i.e.*, order in nature, Pascal's void and arrow of time, to prove the existence of God. The most convincing is the direct experience with God which is the way to fill everyone's inner void (cf. Pascal).

Keywords: Existence, God, order, nature, Pascal's void, arrow of time.

From St. Anselm to Godel and Florensky

Some Western philosophers and theologians have made numerous efforts to prove God's existence, notably, St. Anselm from Canterbury

(1063-1110) and Descartes with their ontological proof of the existence of God. However, Immanuel Kant and Leibniz have shown that such an ontological proof of Descartes inherently believes in God as its premise, therefore, it seems to subject to some kind of "circular logic."

In the 20th century, Godel, a renowned mathematician, secretly wrote down his attempt to refine the ontological proof of St. Anselm using symbolic logic notations. He showed his version of ontological proof to a few younger mathematicians who then put it down in paper and circulated it. That is now known as "Godel's ontological proof of the existence of God." Nonetheless, the use of advanced symbolic logic in Godel's proof makes it only accessible to logicians. Moreover, recent study shows inconsistency of Godel's proof [5].

Apart from such ontological proofs, another proof has been proposed by Pavel Florensky, a Russian physicist who then turned to Orthodox philosopher.[3] His argument can be called "Iconostatic-beauty argument of existence of God." In essence, his argument goes as follows:

An icon in Orthodox tradition was drawn with specific guidelines by Catholic Church. Therefore, the beauty of painting or art works such as in Andrei Rublev's The Holy Trinity can lead us to sense the supernatural, i.e., God Himself.

However, there are others who criticize on Florensky's beauty argument, because it has inherent premise that such an iconic painting, like Rublev's, was really designed to capture the supernatural [3-4].

Therefore, again it seems we come to a kind of circular logic here: To arrive at a proof of existence of God, one should assume He is there.

In the next section, we will argue in favor of Neutrosophic triadic's view to prove the existence of God.

Nature's order, Pascal's void & Arrow of Time as Neutrosophic triadic to prove the existence of God

Neutrosophic logic is a branch of mathematics which studies the dynamics of opposites and neutralities, and it is discovered and developed by Florentin Smarandache [1]. In contrast to Aristotelian logic, where there is no middle way between A and B entities (*The principle of excluded middle*), in Neutrosophic logic there is room for numerous possible middle values (or "neutralities").

In this paper, what we mean with neutrosophic triadic is dynamics of opposites and neutralities among three entities, A, B, C. And we apply this neutrosophic triadic to refer to 3 possible ways to prove the existence of God: Nature's order, Pascal's void and the Arrow of Time. Now let us discuss one by one these triadic arguments:

a. Nature's order:

New findings in modern astronomy as well as other branches of science like biology, have shown that the Universe has great order. Isn't it directly pointing to the Supreme God? As Bohm called it: the Implicate Order and Wholeness.[22] For instance, biological clock, seasons, structure of DNA, up to hierarchies of Cosmos such as planets, stars, galaxies, cluster and supercluster show great harmony, order and beauty. These orders in Universe baffle even the most atheistic philosophers, therefore if we can be humble enough, we should admit that all order and harmony prove God, the Supreme Creator.

As a side note, we can mention the late Antony Flew, a former atheist professor who changed his mind after studying how complex and beautiful our DNA structure is.[6]

Some physicists have argued in terms of Anthropic Principle and Copernican Principle, but actually, instead of saying that all order

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which caused our earth were tuned in order to humanity to exist, we should call it : "reverse-anthropic principle," i.e. the exact orbit of Earth itself shows great order and precision which points to God Himself.

b. Pascal's inner void:

Blaise Pascal once wrote something like this: there is deep void inside everyone, which he/she always try to fill with crafted materials to surround him/her. But that void is actually an infinite abyss, which can only be filled by the Infinite, God Himself. His quote is as follows:

> "What else does this craving, and this helplessness, proclaim but that there was once in man a true happiness, of which all that now remains is the empty print and trace? This he tries in vain to fill with everything around him, seeking in things that are not there the help he cannot find in those that are, though none can help, since this infinite abyss can be filled only with an infinite and immutable object; in other words by God himself." - Blaise Pascal, Pensées VII(425)2

If we accept such Pascal's void, then the deep void itself clearly suggests that everyone of us was created and designed to keep longing to be filled with the Infinite, i.e. God. That is our second argument.

c. Arrow of Time:

Another fact which is very problematic both from physical and and philosophical views is the arrow of time. What is time made of, and why time flows in one direction only? All phenomena and our experiences are governed by the time itself, which is beyond human comprehension.

It seems we will not go too far if we say that the time (chronos and kairos, in Greek) indeed points to the Supreme Controller of Time, i.e., God. See also Laura Mersini-Houghton & Rudy Vaas, The arrows of time (7).

Now, having discussed the neutrosophic triadic as proofs of the existence of God, we will touch upon a deeper issue: How we can experience God, which most religions call it, the mystical experience?

Logic and Mystical Experience

Logic and mystical experiences are exclusive domains that cross over into one another, on occasion, just as everything else does as participants in Experiences of the Wholeness, Harmony, Balance, Caring, and Oneness of the Alive Aware Intelligent Conscious Universe. All of this partly constitutes the Mind of God, which is vaster and more complex than most human beings are able to even vaguely comprehend. As second author (RNB) puts it: *I have been in the Mind of God, so I speak from personal experience.*

The reader may gather, from the basis of Bhutatmas, the tiny Consciousness-experiencing creatures that have vast experiential memories, that Everything, all fields, all forces, all matter, all life, and the entire of the Infinite Cosmos, results from the activities and agglomerations of Bhutatmas, in an Infinite Universe constructed and operated by Intelligent Design.

According to the Vedic literature on this topic, Divinity resides in the Actually Infinitely Small, which is everywhere and nowhere, at the same time. Thus it can and does act on everything that is and everything that happens. But Divinity has set things up so that Everything has Free Will and individual volition. A factor that has been left out of the Vedic literature on the topic of Bhutatmas, is that every Bhutatma is Unique, with a unique set of memories of experiences, regarding multiple Realities (not just this one). So Uniqueness is an absolute in all the realms, and all the Realities.

Conclusions

Neutrosophic logic is a branch of mathematics which studies the dynamics of opposites and neutralities (1). In contrast to Aristotelian

logic, where there is no middle way between A and B entities (The principle of excluded middle), in neutrosophic logic there is room for numerous possible middle values (or "neutralities").

In this paper, what we mean with neutrosophic triadic is dynamics of opposites and neutralities among three entities, A, B, C. And we apply this neutrosophic triadic to refer to 3 possible ways to prove the existence of God: Nature's order, Pascal's void and Arrow of Time.

We hope that this outline of new proof of the existence of God can fill the gap left open by previous study on the proof of the existence of God, from St. Anselm to Godel.

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Miscellaneous articles

From Acoustic Analog of Space to Acoustic Sachs-Wolfe Theorem: A Model of the Universe as a Guitar

Victor Christianto[1*], Florentin Smarandache[2] & Yunita Umniyati[3]

[1]Malang Institute of Agriculture (IPM), Malang, Indonesia
[2]Dept. of Math & Sciences, Univ. of New Mexico, Gallup, New Mexico, USA
[3]Swiss German University (SGU), Tangerang, Indonesia

*Correspondence:
Victor Christianto,
Malang Institute of Agriculture (IPM), Malang, Indonesia.
http://researchgate.net/profile/Victor_Christianto. Email:
victorchristianto@gmail.com

Abstract

It has been known for long time that the cosmic sound wave was there since the early epoch of the Universe. Signatures of its existence are abundant. However, such an acoustic model of cosmology is rarely developed fully into a complete framework from the notion of space up to the sky. This paper may be the first attempt towards such a complete description of the Universe

based on classical wave equation of sound. It is argued that one can arrive at a consistent description of space, elementary particles, Sachs-Wolfe acoustic theorem, starting from this simple classical wave equation of sound. We also discuss a plausible extension of Acoustic Sachs-Wolfe theorem based on its analogue with Klein-Gordon equation to a new equation. It is our hope that the new proposed equation can be verified with observation data. But we admit that our model is still in its infancy, more researches are needed to fill all the missing details.

Keywords: Acoustic metric, acoustic analogue of space, acoustic cosmology, Sachs-Wolfe theorem.

1. Introduction

In one of his papers, the late C.K. Thornhill wrote [1]:

> Relativists and cosmologists regularly refer to space-time without specifying precisely what they mean by this term. Here the two different forms of spacetime, real and imaginary, are introduced and contrasted. It is shown that, in real space-time (x, y, z, ct), Maxwell's equations have the same wave surfaces as those for sound waves in any uniform fluid at rest, and thus that Maxwell's equations are not general and invariant but, like the standard wave equation, only hold in one unique frame of reference. In other words, Maxwell's equations only apply to electromagnetic waves in a uniform ether at rest. But both Maxwell's equations and the standard wave equation, and their identical wave surfaces, transform quite properly, by Galilean transformation, into a general invariant form which applies to waves in any uniform medium moving at any constant velocity relative to the reference-frame. It was the mistaken idea, that Maxwell's equations and the standard wave equation should be invariant, which led, by a mathematical freak, to the Lorentz transform (which demands the non-ether concept and a universally constant wave-speed) and to special relativity. The mistake was further compounded by misinterpreting the differential equation for the wave hypercone through any point as the quadratic differential form of a Riemannian metric in imaginary space-time (x, y, z, ict). Further complications

ensued when this imaginary space-time was generalised to encompass gravitation in general relativity.

In this paper, we will start with a simple premise that the space itself has an acoustic origin and it relates to Maxwell equations. Maxwell equations can be expressed in terms of vortex sound equation. So it will indicate a new interpretation of aether in acoustic terminology.

It is argued that, starting from this simple classical wave equation of sound, one can arrive at a consistent description of space, elementary particles and Sachs-Wolfe acoustic theorem. We also discuss a plausible extension of Acoustic Sachs-Wolfe theorem to a new equation based on its analogue with Klein-Gordon equation.

It is our hope that the proposed new equation can be verified with observation data. It should be noted that this model is still in its infancy.

2. Acoustic Analogue of Space

In this section, we borrow some important ideas from C.K. Thornhill and also Tsutomu Kambe. According to Thornhill, real space-time is a four dimensional space consisting of three- dimensional space plus a fourth length dimension obtained by multiplying time by a constant speed. (This is usually taken as the constant wave-speed c of electromagnetic waves). If the four lengths, which define a four-dimensional metric (x, y, z, ict), are thought of as measured in directions mutually at right-angles, then the quadratic differential form of this metric is [1]:

$$(ds)^2 = (dx)^2 + (dy)^2 + (dz)^2 - \bar{c}^2 (dt)^2 \qquad (1)$$

When the non-differential terms are removed from Maxwell's equations, i.e. when there is no charge distribution or current density, it can easily be shown that the components (E1 ,E2 ,E3) of the electrical field-strength and the components (H1 ,H2 ,H3) of the magnetic field-strength all satisfy the standard wave equation:[1]

$$\nabla\phi = \left(\frac{1}{\bar{c}^2}\right)\frac{\partial^2\phi}{\partial t^2} \tag{2}$$

It follows immediately, therefore, that the wave surfaces of Maxwell's equations are exactly the same as those for sound waves in any uniform fluid at rest, and that Maxwell's equations can only hold in one unique reference-frame and should not remain invariant when transformed into any other reference-frame. In particular, the equation for the envelope of all wave surfaces which pass through any point at any time is, for equation (2), and therefore also for Maxwell's equations,[1]

$$(dx)^2 + (dy)^2 + (dz)^2 = \bar{c}^2(dt)^2 \tag{3}$$

or

$$\frac{(dx)^2}{(dt)^2} + \frac{(dy)^2}{(dt)^2} + \frac{(dz)^2}{(dt)^2} = \bar{c}^2 \tag{4}$$

It is by no means trivial, but it is, nevertheless, not very difficult to show, by elementary standard methods, that the general integral of the differential equation (4), which passes through (x1, y1, z1) at time t1, is the right spherical hypercone [1]:

$$(x - x_1)^2 + (y - y\ )^2 + (z - z_1)^2 = \bar{c}^2(t - t_1)^2 \tag{5}$$

In other words, both Maxwell equations and space itself has the sound wave origin. We shall see later that this interpretation of Thornhill's work is consistent with the so-called acoustic Sachs- Wolfe theorem which is known in cosmology setting.

It is also interesting to remark here that Maxwell equations can be cast in the language of vortex sound theory, as follows.

T. Kambe from University of Tokyo has made a connection between the equation of vortex sound and fluid Maxwell equations. He wrote

that it would be no exaggeration to say that any vortex motion excites acoustic waves. He considers the equation of vortex sound of the form: [2]:

$$\frac{1}{c^2}\partial_t^2 p - \nabla^2 p = \rho_0 \nabla . L = \rho_0 div(\omega \times v) \tag{6}$$

He also wrote that dipolar emission by the vortex-body interaction is:[3]

$$p_F(x,t) = -\frac{P_0}{4\pi c}\dot{\Pi}_i(t - \frac{x}{c})\frac{x_c}{x^2} \tag{7}$$

Then he obtained an expression of fluid Maxwell equations as follows [4]:

$$\begin{aligned} &\nabla \cdot H = 0 \\ &\nabla \cdot E = q \\ &\nabla \times E + \partial_t H = 0 \\ &a_0^2 \nabla \times H - \partial_t E = J \end{aligned} \tag{8}$$

where [4] a_0 denotes the sound speed, and

$$\begin{aligned} &q = -\partial_t(\nabla \cdot \upsilon) - \nabla \hbar, \\ &J = \partial_t^2 v + \nabla \partial_t h + a_o^2 \nabla \times (\nabla \times \upsilon) \end{aligned} \tag{9}$$

In our opinion, this new expression of fluid Maxwell equations suggests that there is a deep connection between vortex sound and electromagnetic fields. However, it should be noted that the above expressions based on fluid dynamics need to be verified with experiments. We should note also that in (8) and (9), the speed of sound a0 is analogous of the speed of light in Maxwell equations, whereas in equation (6), the speed of sound is designated “c” (as analogous to the light speed in EM wave equation). For alternative hydrodynamics expression of electromagnetic fields, see [7].

The above interpretation of fluid Maxwell equations from vortex sound theory has been discussed in our recent paper, to appear in forthcoming issue of JCMNS [5].

3. Comparison between Schrödinger equation and Classical wave equation of sound

In the initial variant, the Schrodinger equation (SE) has the following form [8]:

$$\Delta\Psi + \frac{2m}{\hbar^2}\left(W + \frac{e^2}{4\pi\varepsilon_o r}\right)\Psi = 0 \tag{10}$$

The wave function satisfying the wave equation (10) is represented as:

$$\Psi = R(r)\Theta(\theta)\Phi(\varphi)T(t) = \psi(r,\theta,\varphi)T(t) \tag{11}$$

where ψ (r,θ ,φ) = R(r)Θ(θ)Φ(φ) is the complex amplitude of the wave function, because

$$\Phi_m(\varphi) = C_m e^{\pm im\varphi} \tag{12}$$

For standard method of separation of variables to solve spherical SE, see for example [11-13].

The Φ, Θ and T equations were known in the theory of wave fields. Hence these equations presented nothing new. Only the R was new. Its solution turned out to be divergent. However, Schrödinger together with H. Weyl (1885-1955), contrary to the logic of and all experience of theoretical physics, artificially cut off the divergent power series of the radial function R(r) at a κ-th term. This allowed them to obtain the radial solutions, which, as a result of the cut off operation, actually were the fictitious solutions [8].

Furthermore, it can be shown that the time-independent SE [9][10]:

$$\nabla\Psi + \frac{2m}{\hbar^2}(E - V)\Psi = 0, \tag{13}$$

can be written in the form of standard wave equation [8]:

$$\nabla\Psi + k^2\Psi = 0, \tag{14}$$

where

$$k = \pm\sqrt{\frac{2m}{\hbar^2}(E - V)}\,. \tag{15}$$

or if we compare (14) and (10), then we have [8]:

$$k = \pm\sqrt{\frac{2m}{\hbar^2}\left(W + \frac{e^2}{4\pi\varepsilon_o r}\right)}\,. \tag{16}$$

This means that the wave number k in Schrödinger's radial wave equation is a quantity that varies continuously in the radial direction. Is it possible to imagine a field where the wave number, and hence the frequency, change from one point to another in the space of the field? Of course, it is not possible. Such wave objects do not exist in Nature.

The unphysical nature of Schrödinger wave-function has created all confusing debates throughout 90 years. But it is rarely discussed in QM textbooks, on how he arrived at his equation. It is known that Schrodinger began with Einstein's mass-energy relation then he proceeded with Hamilton-Jacobian equation. At first he came to a similar fashion of Klein- Gordon equation, but then he arrived to a new equation which is non-relativistic. Logically speaking, he began with a relativistic assumption and he came to a nonrelativistic expression, and until now physicists remain debating on how to relativize Schrodinger equation. That is logically inconsistent and therefore unacceptable, and Schrodinger himself never knew where the problem lies. Until now people remain debating the problem of the meaning of his wavefunction, but it starts with unphysical nature of his equation. This is a common attitude of many young physicists who tend to neglect the process and logical implication of QM derivation, and they never asked about whether Schrodinger equation has deep logical inconsistency or not.

Moreover, there are some limitations in applying Schrödinger equation to experiments, although many textbooks on QM usually overlook existing problems on how to compare 3D spherical solution of Schrodinger equation with experimental data. The contradiction between QM and experiments are never discussed publicly, and this is why the most modern physicists hold the assertion that QM describes accurately "ALL" physical experiments; that is an unfounded assumption. George Shpenkov began with classical wave equation and he is able to derive a periodic table of elements which is very close to Mendeleev's table. And this is a remarkable achievement which cannot be done with standard wave mechanics.[23]

Nonetheless, equation (14) and (15) which suggests analogy between wave mechanics and sound wave equation has been discussed briefly by Hilbert & Batelaan [14]. And it seems worthy to explore further in experiments.

4. Derivation of Klein-Gordon equation from the Classical Wave equation

It is also possible to find theoretical correspondence between classical electromagnetic wave equation and Klein-Gordon equation. Such a correspondence has been discussed by David Ward & Sabine Volkmer [15]. They give a simple derivation of the KGE, which requires only knowledge of the electromagnetic wave equation and the basics of Einstein's special theory of relativity.

They begin with electromagnetic wave equation in one dimensional case:

23 For further discussion, it is advisable to check the website of Dr. George Shpenkov, at http://shpenkov.janmax.com. See especially Shpenkov, George P. 2013. Dialectical View of the World: The Wave Model (Selected Lectures). Volume I: Philosophical and Mathematical Background. URL: http://shpenkov.janmax.com/Vol.1.Dialectics.pdf

$$\frac{\partial^2 E}{\partial x^2} - \frac{1}{c^2}\frac{\partial^2 E}{\partial t^2} = 0 \tag{17}$$

This equation is satisfied by plane wave solution:

$$E(x,t) = E_0 e^{i(kx-\omega t)} \tag{18}$$

Where $k = \frac{2\pi}{\lambda}$ and $\lambda = 2\pi\nu$ are the spatial and temporal frequencies, respectively. Substituting equation (18) into (17), then we obtain:

$$\left(\frac{\partial^2}{\partial x^2} - \frac{1}{c^2}\frac{\partial^2}{\partial t^2}\right) E_0 e^{i(kx-\omega t)} = 0 \tag{19}$$

or

$$\left(k^2 - \frac{\omega^2}{c^2}\right) E_0 e^{i(kx-\omega t)} = 0 \tag{20}$$

Solving the wave vector, we arrive at dispersion relation for light in free space: $k = \frac{\omega}{c}$. Note that this is similar to wave number k in equation (14).

Then, recall from Einstein and Compton that the energy of a photon is $\varepsilon = h\nu = \hbar\omega$ and the momentum of a photon is $p = \frac{h}{\lambda} = \hbar k$. We can rewrite equation (18) using these relations:

$$E(x,t) = E_0 e^{\frac{i}{\hbar}(px-\varepsilon t)}, \tag{21}$$

Substituting this equation into (17) we find:

$$-\frac{1}{\hbar^2}\left(p^2 - \frac{\varepsilon^2}{c^2}\right) E_0 e^{\frac{i}{\hbar}(px-\varepsilon t)} = 0 \tag{22}$$

Then we get an expression of relativistic total energy for a particle with zero rest mass:

$$\varepsilon^2 = p^2c^2 . \tag{23}$$

We now assume with de Broglie that frequency and energy, and wavelength and momentum, are related in the same way for classical particles as for photons, and consider a wave equation for non-zero rest mass particles. So we want to end up with:

$$\varepsilon^2 = p^2c^2 + m^2c^4 \tag{24}$$

Inserting this equation (24) into equation (22), it is straightforward from (19), that we get:

$$\left(\nabla^2 - \frac{m^2c^2}{\hbar^2}\right)\Psi = \frac{1}{c^2}\frac{\partial^2\Psi}{\partial t^2} \tag{25}$$

which is the Klein-Gordon equation for a free particle [15].

Having derived KGE from classical electromagnetic wave equation, now we are ready to discuss its implication in description of elementary particles. This will be discussed in the next section.

Interestingly, it can be shown that by using KGE one can describe hydrogen atom including electron spin without having to resort to the complicated Dirac equation [16]. It also appears worthnoting here that Meessen workout a description of elementary particles from excitation of spacetime, by starting from KGE and a novel assumption of quantized spacetime dx=n.a.[17] However, we will not discuss Ducharme's and Meessen's approach here, instead we will put more attention on how to extend Acoustic Sachs-Wolfe theorem by virtue of KGE.

5. Acoustic Sachs-Wolfe theorem and its plausible extension

According to Czaja, Golda, and Woszczyna [19], if one considers the acoustic field propagating in the radiation-dominated (p= ε /3)

universe of arbitrary space curvature (K=0,±1), then the field equations are reduced to the d'Alembert equation in an auxiliary static Robertson-Walker spacetime. This is related to the so-called *Sachs-Wolfe acoustic theorem*, which can be found useful in the observation and analysis of Cosmic Microwave Background anisotropies.

In the meantime, there are papers suggesting that the integrated Sachs-Wolfe theorem may be useful to study dark energy, but we do not enter in such a discussion. See [22] for instance. The Sachs–Wolfe acoustic theorem refers to the spatially flat (K=0), hot ($p=\varepsilon/3$) Friedmann– Robertson–Walker universe and the scalar perturbation propagating in it. The theorem states that with the appropriate choice of the perturbation variable, one can express the propagation equation in the form of d'Alembert's equation in Minkowski spacetime. Scalar perturbations in the flat, early universe propagate like electromagnetic or gravitational waves ([18], p. 79).

On the other hand, the wave equation for the scalar field of the dust (p=0) cosmological model can be transformed into the d'Alembert equation in the static Robertson–Walker spacetime, regardless of the universe's space curvature (see [18]). Therefore, we can suppose that the flatness assumption in the Sachs–Wolfe theorem is not needed and that the theorem is true in the general case. The proof of this fact, formulated as a symbolic computation, is presented in the first section of this paper.

In accordance with Czaja, Golda, and Woszczyna [19], we begin with Robertson–Walker metrics in spherical coordinates $x^\sigma=\{\eta,\chi,\vartheta,\phi\}$:

$$g_{(RW)}=a^2(\eta)\begin{bmatrix} -1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & \dfrac{\sin^2(\sqrt{K}\chi)}{K} & 0 \\ 0 & 0 & 0 & \dfrac{\sin^2(\sqrt{K}\chi)\sin^2(\vartheta)}{K} \end{bmatrix} \tag{26}$$

with the scale factor a(□) appropriate for the equation of state p= □/3

$$a(\eta) = \frac{\sin(\sqrt{K}\chi)}{\sqrt{K}} \tag{27}$$

Let us define a new perturbation variable □ with the help of the second-order differential transformation of the density contrast □,

$$\Psi(x^{\sigma}) = \frac{1}{\cos(\sqrt{K}\chi)}\frac{\partial}{\partial\eta}\left(\frac{K}{\tan^2(\sqrt{K}\chi)}\frac{\partial}{\partial\eta}\left(\frac{\tan^2(\sqrt{K}\chi)}{K}\cos(\sqrt{K}\chi)\delta(x^{\sigma})\right)\right). \tag{28}$$

The function $\Psi(x^{\sigma})$ is the solution of the d'Alembert equation:

$$\frac{\partial^2}{\partial\eta^2}\Psi(x^{\sigma}) - \frac{1}{3}\Delta\Psi(x^{\sigma}) = 0, \tag{29}$$

with the Beltrami–Laplace operator Δ acting in this space,

$${}^{(3)}g = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \dfrac{\sin^2(\sqrt{K}\chi)}{K} & 0 \\ 0 & 0 & \dfrac{\sin^2(\sqrt{K}\chi)\sin^2(\vartheta)}{K} \end{bmatrix}. \tag{30}$$

The Beltrami–Laplace operator Δ is defined as follow

$$\Delta = {}^{(3)}\, g_{mn}\nabla^m\nabla^n. \tag{31}$$

And it can be considered as an extension of Laplace operator for curved space.

Now let us discuss a basic question: what is Laplace-Beltrami operator? In differential geometry, the Laplace operator can be generalized to operate on functions defined on surfaces in Euclidean space and, more generally, on Riemannian and pseudo-Riemannian manifolds. This more general operator goes by the name Laplace-Beltrami operator, after Pierre-Simon Laplace and Eugenio Beltrami. Like the Laplacian, the Laplace-Beltrami operator is defined as the divergence of the gradient, and is a linear operator taking functions into functions. The operator can be extended to operate on tensors as

the divergence of the covariant derivative. Alternatively, the operator can be generalized to operate on differential forms using the divergence and exterior derivative. The resulting operator is called the Laplace-de Rham operator (named after Georges de Rham).

Now, considering the formal equivalence between the form of (29) with KGE (25), minus the mass term, then it seems reasonable to include the mass term into (29). Then the extended version of equation (29) may be written as:

$$\frac{\partial^2}{\partial \eta^2}\Psi\left(x^\sigma\right)-\frac{1}{3}\Delta\Psi\left(x^\sigma\right)=-I\frac{m^2c^2}{\hbar^2}\Psi, \tag{32}$$

where I is identity matrix as follows:

$$I=\begin{bmatrix}1 & 0 & 0\\ 0 & 1 & 0\\ 0 & 0 & 1\end{bmatrix}. \tag{33}$$

The above equations (32) and (33) can be considered as a plausible extension of Acoustic Sachs- Wolfe theorem based on its analogue with Klein-Gordon equation to become Acoustic Sachs- Wolfe-Christianto-Smarandache-Umniyati (ASWoCSU) equation. Its usefulness remains to be verified with observation data.

6. Discussion and Concluding Remarks

It has been known for long time that the cosmic sound wave was there since the early epoch of the Universe. Signatures of its existence are abound.[24] However, such an acoustic model of cosmology is rarely developed fully into a complete framework from the notion of space, cancer therapy up to the sky. This paper may be the first attempt towards such a complete description of the Universe based on classical wave equation of sound.

We have discussed how the very definition of Newtonian space can be related to sound wave and also Maxwell equations, and also how

fluid Maxwell equations can be formulated based on vortex sound theory.

We have also discussed the inadequacies of Schrodinger equation as a description of elementary particles, instead we established connection from classical electromagnetic wave equation to Klein-Gordon equation.

Then we discuss Acoustic Sachs-Wolfe theorem which is worthy to investigate further in the context of cosmology. We also propose an extension of Acoustic Sachs-Wolfe to become a new equation. In other words, it appears very reasonable to model the Universe and Cosmos in general in terms of sound wave equation.

To summarize, in this paper we tried our best to offer a novel picture of the Universe as a guitar. Further observation and experiments are recommended to verify the above propositions.

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A Numerical Solution of Ermakov Equation Corresponding to Diffusion Interpretation of Wave Mechanics

Victor Christianto[1*] & Florentin Smarandache[2]

[1]Malang Institute of Agriculture (IPM), Malang, Indonesia
[2]Dept. of Math & Sciences, Univ. of New Mexico, Gallup, New Mexico, USA

*Correspondence:
Victor Christianto, Malang Institute of Agriculture (IPM), Malang, Indonesia.
http://researchgate.net/profile/Victor_Christianto.
Email: victorchristianto@gmail.com

Abstract

It has been long known that a year after Schrödinger published his equation, Madelung also published a hydrodynamics version of Schrödinger equation. Quantum diffusion is studied via dissipative Madelung hydrodynamics. Initially the wave packet spreads ballistically, then passes for an instant through normal diffusion and later tends asymptotically to a sub-diffusive law. In this paper we will review two different approaches, including Madelung hydrodynamics and also Bohm potential. Madelung formulation leads to

diffusion interpretation, which after a generalization yields to Ermakov equation. Since Ermakov equation cannot be solved analytically, then we try to find out its solution with *Mathematica* package. It is our hope that these methods can be verified and compared with experimental data. But we admit that more researches are needed to fill all the missing details.

Keywords: Quantum hydrodynamics, quantum diffusion, quantum-classical correspondence, Madelung equation, Ermakov equation, computer algebra solution.

1. Introduction

The Copenhagen interpretation of quantum mechanics is guilty for the quantum mystery and many strange phenomena such as the Schrödinger cat, parallel quantum and classical worlds, wave-particle duality, decoherence, collapsing wave function, etc. The Copenhagen interpretation of QM was challenged not only by Schrödinger but also by a large group of physicists led by Albert Einstein who claimed that the quantum mechanical description of the physical reality cannot be considered complete, as shown in their famous EPR paper Einstein, Podolsky and Rosen. They concluded their derivations by stating that *"While we have thus shown that the wave function does not provide a complete description of the physical reality, we left open the question of whether or not such a description exists. We believe, however that such a theory is possible."* Einstein did not object to the probabilistic description of sub-atomic phenomena in quantum mechanics. However, he believed that this probabilistic representation was a technique used to overcome the practical difficulties of dealing with a more complicated underlying physical reality, much in the same way he suggested earlier to deal with Brownian motion.

Many scientists have tried, however, to put the quantum mechanics back on *ontological* foundations. For instance, Bohm proposed an alternative interpretation of quantum mechanics, which is able to overcome some puzzles of the Copenhagen interpretation. He

developed further the de Broglie pilot-wave theory and, for this reason, the Bohmian mechanics is also known as the de Broglie-Bohm theory. [2]

Long before the Bohmian mechanics proposal, a year after Erwin Schrödinger published his celebrated equation, Erwin Madelung showed (in 1927) that it can be written in a hydrodynamic form. Madelung's representation has a seemingly major disadvantage by transforming the linear Schrödinger equation into two nonlinear ones. Nonetheless, despite of its additional complexity, the hydrodynamic analogy provides important insights with regard to the Schrödinger equation. Quantum diffusion is studied via dissipative Madelung hydrodynamics. Initially the wave packet spreads ballistically, thenn passes for an instant through normal diffusion and later tends asymptotically to a sub-diffusive law.

Quantum diffusion (QD) describes a wave packet spreading in a dissipative environment at zero temperature. Since quantum effects are significant for light particles mainly, QD is very essential for electrons, which on the other hand are very important in physics and chemistry. QD has been experimentally observed, however, for muons as well, which are about 200 times heavier than electrons. Studies on electron transport in solids are strongly motivated by the semiconductor industry, exploring nowadays quantum effects on nanoscale.[4]

Another important transport process affected by quantum effects is the diffusion of hydrogen atoms or molecules in metals and on solid surfaces. The quantum tunneling accelerates the hydrogen diffusion, which is essential for many modern technologies for storage and use of hydrogen as a fuel, chemical reagent, etc.[4]

In this paper we will review two different approaches, including Madelung hydro-dynamics and also Bohm potential. It can be shown that Madelung formulation leads to diffusion interpretation, which after a generalization yields to Ermakov equation. Since Ermakov equation cannot be solved analytically, then we try to find out its

solution with Mathematica package. It is our hope that these methods can be verified and compared with experimental data. For other papers discussing the use of Ermakov equation in QM, see [8]-[12].

Nonetheless, we admit that more researches are needed to fill all the missing details, for example we do not yet discuss comparison between quantum trajectories and classical trajectories such as in Wilson chamber experiments.

2. Bohmian quantum potential [2]

The evolution of the wave function of a quantum mechanical system consisting of N particles is supposed to be described by the Schrödinger equation:

$$i\eta\partial_t\psi = \left(-\frac{\eta^2}{2m}\nabla + U\right)\psi. \tag{1}$$

The complex wave function can be presented generally in the polar form:

$$\psi = \sqrt{\rho}\exp\left(\frac{iS}{h}\right), \tag{2}$$

Where $\rho = |\psi|^2$ is the N-particles distribution density and $\frac{S}{\eta}$ is the wave function phase.

Introducing equation (2) into (1) one gets a set of equations:

$$\partial_t\rho = -\nabla.(\rho\nabla S/m), \tag{3}$$

$$\partial_t S + \frac{(\nabla S)^2}{2m} + U + Q = 0, \tag{4}$$

Where quantum potential, Q, is defined as follows:

$$Q = -\frac{\eta^2}{2m^2}\frac{\nabla^2\sqrt{\rho}}{\sqrt{\rho}}. \tag{5}$$

Equation (5) is called Bohmian quantum potential.[2]

3. Madelung Quantum Potential [2]

If one starts with a different assumption that in equation (3) S is the hydrodynamic-like velocity potential, not the mechanical action as suggested by Bohm, then he can arrive at different relations, such as the two equations proposed by Madelung as follows:

$$\partial_t \rho = -\nabla.(\rho V), \tag{6}$$

$$m\partial V + mV \cdot \nabla V = -\nabla(U + Q), \tag{7}$$

where

$$V = \nabla S / m\,. \tag{8}$$

Equations (6) and (7) are known as the Madelung quantum hydrodynamics.[2]

4. Quantum Diffusion and Ermakov equation. Numerical solution

Quantum diffusion is studied via dissipative Madelung hydrodynamics. Initially the wave packet spreads ballistically, then passes for an instant through normal diffusion and later tends asymptotically to a sub-diffusive law.

Now, we start with Madelung equations (6)(7)(8), then introducing now both expressions for ρ and V in Eq. (7) yields the following equation:[4]

$$m\partial_t^2 \sigma + b\partial_t \sigma = \frac{\eta^2}{4m\sigma^3}, \tag{9}$$

describing the evolution of the root-mean-square displacement σ. Introducing new dimensionless dispersion and time parameters, Eq. (9) acquires the universal form of a dissipative Ermakov equation:

$$\partial_\tau^2 \xi + \partial_\tau \xi = \xi^{-3}, \tag{10}$$

where

$$\xi^2 \equiv \frac{2b\sigma^2}{\eta} \tag{11}$$

$$\tau = bt/m. \tag{12}$$

It is known that such an Ermakov equation cannot be solved analytically. In reference [4], solutions have been obtained for some limiting cases. Now we will try to find numerical solution using Mathematica package using NDSolve, as follows:

```
ODE=x''[t]+x'[t]-1/x[t]^3==0;
sol=NDSolve[{ODE,x[0]==1,x'[0]==1},x[t],{t,-10,10}]
Plot[x[t]/.sol,{t,-10,10}]
```

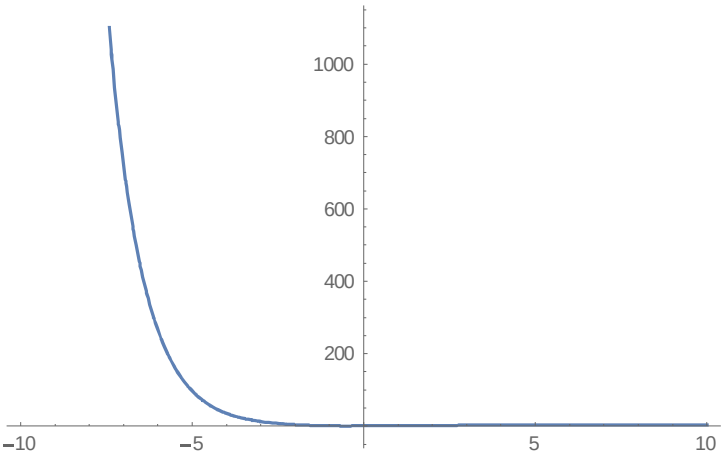

Figure 1. Plot for numerical solution of Ermakov equation

5. Discussion and Conclusion

We have discussed two different approaches, including Madelung hydrodynamics and also Bohm potential. Madelung formulation leads to diffusion interpretation, which after a generalization yields to Ermakov equation. Since Ermakov equation cannot be solved analytically, then we try to find out its solution with *Mathematica* package.

We have obtained numerical solution of Ermakov equation corresponding to diffusion interpretation of QM. For other papers discussing the use of Ermakov equation in QM, see [8]- [12]. It is our hope that these methods can be verified and compared with experimental data. Nonetheless, we admit that more researches are needed to fill all the missing details, for example we do not yet discuss comparison between quantum trajectories and classical trajectories such as in Wilson chamber experiments.

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From Zeldovich Approximation to Burgers' Equation: A Plausible Route to a Cellular Automata Adhesion Universe

Victor Christianto[1*] & Florentin Smarandache[2]

[1]Malang Institute of Agriculture (IPM), Malang, Indonesia
[2]Dept. Mathematics and Sciences,
University of New Mexico, NM, USA

*Correspondence:
Victor Christianto, Malang Institute of Agriculture (IPM),
Malang, Indonesia.
Email: victorchristianto@gmail.com

Abstract

Some years ago, Hidding *et al*. suggest that the emergence of an intricate and pervasive web-like structure of the Universe on Megaparsec scales can be approximated by a well-known equation from fluid mechanics, the Burgers' equation. The solution to this equation can be obtained from a geometrical formalism. The resulting Adhesion formalism provides deep insight into the dynamics and topology of the Cosmic Web. It uncovers a direct connection

between the conditions in the very early Universe and the complex spatial patterns that emerged out of these under the influence of gravity. In the present paper, we describe a cellular automaton model of the Burgers' equation, which can be investigated via a fast computer simulation. In the end, this suggests a Cellular Automata Adhesion Model of the Universe.

Keywords: Discrete physics, cosmology, large scale structure, universe, numerical methods, cellular automata, Burgers equation, Zeldovich approximation.

1. Introduction

The Cosmic Web is the fundamental spatial organization of matter on scales of a few up to a hundred Megaparsecs. Galaxies and intergalactic gas matter exist in a wispy web-like arrangement of dense compact clusters, elongated filaments, and sheet-like walls, amidst large near-empty void regions. The filaments are the transport channels along which matter and galaxies flow into massive high-density clusters located at the nodes of the web. The web-like network is shaped by the tidal force field accompanying the inhomogeneous matter distribution [1].

Structure in the Universe has risen out of tiny primordial (Gaussian) density and velocity perturbations by means of gravitational instability. The large-scale anisotropic force field induces anisotropic gravitational collapse, resulting in the emergence of elongated or flattened matter configurations. The simplest model that describes the emergence of structure and complex patterns in the Universe is the Zeldovich Approximation (ZA) [1]. It is our hope that the new approach of the CA Adhesion model of the Universe can be verified either with lab experiments, computer simulation, or by large-scale astronomy observation data.

2. From Zeldovich Approximation to Burgers' Equation to the Cellular Automaton model

In this section, we will outline a route from ZA to Burgers' equation and then to the CA model. The simplest model that describes the emergence of structure and complex patterns in the Universe is the Zeldovich Approximation (ZA). In essence, it describes a ballistic flow, driven by a constant (gravitational) potential. The resulting Eulerian position x(t) at some cosmic epoch t is specified by the expression [1]:

$$x(t) = q + D(t)u_o(q), \tag{1}$$

where q is the initial "Lagrangian" position of a particle, D(t) the time-dependent structure growth factor and

$$u_0 = -\nabla_q \Phi_0 \tag{2}$$

its velocity. The nature of this approximation may be appreciated by the corresponding source- free equation of motion,

$$\frac{\partial u}{\partial D} + (u \cdot \nabla_x)u = 0. \tag{3}$$

The use of ZA is ubiquitous in cosmology. One major application is its key role in setting up initial conditions in cosmological N-body simulations. Of importance here is its nonlinear extension in terms of the *Adhesion Model* [1].

The ZA breaks down as soon as self-gravity of the forming structures becomes important. To 'simulate' the effects of self-gravity, Gurbatov et al. included an artificial viscosity. This results in the Burgers' equation as follows [1]:

$$\frac{\partial u}{\partial D} + (u \cdot \nabla_x)u = \nu.\nabla_x^2 u, \tag{4}$$

a well-known PDE from fluid mechanics. This equation has an exact analytical solution, which in the limit of $\nu \to 0$, the solution is [1]:

$$\phi(x, D) = \max_q \left[\Phi_0(q) - \frac{(x-q)^2}{2D} \right]. \tag{5}$$

This leads to a geometric interpretation of the Adhesion Model. The solution follows from the evaluation of the convex hull of the velocity potential modified by a quadratic term. We found that the solution can also be found by computing the weighted Voronoi diagram of a mesh weighted with the velocity potential. For more detailed discussion on the Adhesion Model of the Universe, see for example [4].

Now, let us consider another route to solve Burgers' equation: (a) by numerical computation with *Mathematica*, see [3]; and (b) by virtue of the CA approach. Let us skip route (a) and discuss a lesser known approach of cellular automata.

We start with the Burgers' equation with Gaussian white noise that can be rewritten as follows [2]:

$$\frac{\partial u}{\partial t} + \xi = 2u\frac{\partial u}{\partial x} + \frac{\partial^2 u}{\partial x^2} + \eta. \tag{6}$$

By introducing new variables and straightforward calculations afterwards, we have the automata rule [2]:

$$\begin{aligned}\phi_i^{t+1} &= \phi_{i-1}^t + \max[0, \phi_i^t - A, \phi_i^t + \phi_{i+1}^t - B, \Psi_i^t - \phi_{i-1}^t] \\ &- \max[0, \phi_{i-1}^t - A, \phi_{i-1}^t + \phi_i^t - B, \Phi_i^t + \phi_{i-1}^t]\end{aligned} \tag{7}$$

In other words, in this section we give an outline of a plausible route from ZA to Burgers' equation and then to the CA model, which suggests that it appears possible – at least in theory – to consider a nonlinear cosmology based on the CA Adhesion model.

3. Concluding Remarks

The use of ZA is ubiquitous in cosmology. One major application is its key role in setting up initial conditions in cosmological N-body simulations. Of importance here is its nonlinear extension in terms of the Adhesion Model. In this paper, we give an outline of a plausible route from ZA to Burgers' equation then to the CA model, which suggests that it appears theoretically possible to consider a nonlinear cosmology based on CA Adhesion model.

This paper is part of our theoretical investigation of plausible nonlinear cosmology models beyond Navier-Stokes-inspired approaches.

It is our hope that the proposed approach can be verified with a more extensive computer simulation and (astronomy) observation data.

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On Maxwell-Dirac Isomorphism

Victor Christianto[1*], Florentin Smarandache[2]

[1]Malang Institute of Agriculture (IPM), Malang, Indonesia.
[2]Dept. of Math. Sci., Univ. of New Mexico, Gallup, USA

*Correspondence:
Victor Christianto, Malang Institute of Agriculture (IPM),
Malang, Indonesia.
Email: victorchristianto@gmail.com

Abstract

In this paper, we discuss Maxwell-Dirac isomorphism and quantum entanglement.

Keywords: Quantum entanglement, metaphysics, realism, Maxwell-Dirac isomorphism.

1. Introduction

In its simplest form, the features of quantum theory can be reduced to: (a) a wave function description of microscopic entities; and (b) entanglement. Entanglement is a key property that makes quantum information theory different from its classical counterpart [14].

But what is entanglement? Wootter gives one of clearest description [13]:

> In both classical mechanics and quantum mechanics, one can define a pure state to be a state that is as completely specified as the theory allows. In classical mechanics a pure state might be represented by a point in phase space. In quantum mechanics it is a vector in a complex vector space. Perhaps the most remarkable feature of quantum mechanics, a feature that clearly distinguishes it from classical physics, is this: for any composite system, there exist pure states of the system in which the parts of the system do not have pure states of their own. Such states are called entangled.

According to Scolarici and Solombrino [5]:

> The essential difference in the concept of state in classical and quantum mechanics is clearly pointed out by the phenomenon of entanglement, which may occur whenever the product states of a compound quantum system are superposed. Entangled states play a key role in all controversial features of QM; moreover, the recent developments in quantum information theory have shown that entanglement can be considered a concrete physical resource that it is important to identify, quantify and classify.

Nonetheless, they concluded that "our research has pointed out a puzzling situation, in which the same state of a physical system is entangled in CQM, while it seems to be separable in QQM."

While entanglement is usually considered as purely quantum effect, it by no means excludes the possibility to describe it in a classical way.

In this regard and from the history of QM, we learn that there were many efforts to describe QM features in a more or less classical picture. For example, in 1927 Einstein presented his version of the hidden variable theory of QM, starting from Schrödinger's picture, which seems to influence his later insistence that "*God does not play dice*" [6][7].

Efforts have also been made to extend QM to QQM (quaternionic quantum mechanics), for instance by Stephen Adler from IAS [8].

In recent decades, however, another route began to appear, which may be called the Maxwell- Dirac isomorphism route, where it can be shown that there is close link between Maxwell's equations of classical electromagnetism and the Dirac equation of the electron. Intuitively, this may suggest that there is a one-to-one correspondence between the electromagnetic wave and quantum wave function. But can it offer a classical description of entanglement? This problem will be explored in the next sections.

2. A Few Alternatives of a Realistic Maxwell-Dirac Isomorphism

There are some papers dealing with the formal connection between classical electrodynamics and wave mechanics, especially there are some existing proofs on the Maxwell-Dirac isomorphism. We will review here two derivations of the Maxwell-Dirac isomorphism, i.e., by Hans Sallhofer and Volodimir Simulik. In the last section, we will also discuss a third option, i.e., by exploring the Maxwell-Dirac isomorphism through quaternionic language.

a. Sallhofer's method

Summing up one of Sallhofer's papers [1], he says that under the sufficiently general assumption of periodic time dependence, the following connection exists between source-free electro- dynamics and wave mechanics:

$$\sigma \cdot \left[\begin{array}{c} rotE + \dfrac{\mu}{c}\dfrac{\partial}{\partial t} H = 0 \\ rotH - \dfrac{\varepsilon}{c}\dfrac{\partial}{\partial t} H = 0 \\ div \varepsilon E = 0 \\ div \mu H = 0 \end{array} \right]_{divE=0} \equiv \left[(\gamma \cdot \nabla + \gamma^{(4)} \partial_4) \Psi = 0 \right] \tag{1}$$

That is, the multiplication of source-free electrodynamics by the Pauli-vector yields wave mechanics [1].

In simple terms, this result can be written as follows:

$$P \cdot M = D \tag{2}$$

where P = Pauli vector, M = Maxwell's equations and D = the Dirac equation.

We can also say that wave mechanics is a solution-transform of electrodynamics. Here, one has to bear in mind that the well-known circulatory structure of the wave functions, manifest in Dirac's hydrogen solution, is not introduced just by the Pauli-vector [1].

b. Simulik's method

Simulik described another derivation of the Maxwell-Dirac isomorphism. In one of his papers [2], he wrote a theorem suggesting that Maxwell's equations of source-free electrodynamics which can be written as follows:

$$\begin{aligned} rotE + \frac{\mu}{c}\frac{\partial}{\partial t}H &= 0 \\ rotH - \frac{\varepsilon}{c}\frac{\partial}{\partial t}H &= 0 \\ divE &= 0 \\ divH &= 0 \end{aligned} \tag{3}$$

are equivalent to the Dirac-like equation [2]:

$$\left[\gamma.\nabla - \begin{pmatrix} \varepsilon 1 & 0 \\ 0 & \mu 1 \end{pmatrix}\frac{1}{c}\frac{\partial}{\partial t}\right]\Psi^{c1} = 1, \tag{4}$$

where in the usual representation

$$\gamma = \begin{pmatrix} 0 & \sigma \\ \sigma & 0 \end{pmatrix}, \tag{5}$$

and σ are the well-known Pauli matrices.

c. Maxwell-Dirac isomorphism through Quaternionic language

In text books, quantum theory is based on complex numbers of the form a_0+a_1i, with i being the imaginary unit $i^2 = -1$. It has long been

known that an alternative quantum mechanics can be based on the quaternion or hyper-complex numbers of the form $a_0 + a_1 i + a_2 j + a_3 k$, with i, j, k being three non-commuting imaginary units [8].

On the other hand, recognizing that Maxwell's equations were originally formulated in terms of quaternionic language, some authors investigated whether there could be a formal correspondence between Maxwell's and Dirac's equations. Kravchenko and Arbab are a few researchers who worked on this problem. And also the present authors arrived at a similar conclusion despite using different procedures based on the Gersten decomposition of the Dirac equation [4].

This MD isomorphism can also be extended further to the classical description of boson mass, which was usually called the Higgs boson [3], so it may be a simpler option compared to scale symmetry theory.

3. Quaternionic QM & Entanglement

Singh & Prabakaran are motivated to examine the geometry of a two-qubit quantum state using the formalism of the Hopf map. The "quaternions" again come in handy in studying the two- qubit state. [10]

In his exposition of *Quaternionic Quantum Mechanics*, Singh concluded that [9]:

> Having established the compatibility of the Hopf fibration representation with the conventional theory for unentangled states, let us, now, address the issue of measurability of entanglement in this formalism. In the context, "Wootters' Concurrence" and the related "Entanglement of Formation" constitute well accepted measures of entanglement, particularly so, for pure states. ...It follows that any real linear combination of the "magic basis" would result in a fully entangled state with unit concurrence. Conversely, any completely entangled state can be written as a linear combination in the "magic basis" with real components, up to an overall phase factor. In

> fact, these properties are not unique to a state description in the "magic basis" and hold in any other basis that is obtained from the "magic basis" by an orthogonal transformation...

In a rather different way, Najarbashi et al. explored quaternionic Möbius transformations, which can be useful in theoretical physics in areas such as quaternionic quantum mechanics, quantum conformal field theory and quaternionic computations [11]. They found that "*as in the case of two-qubits, both octonionic stereographic projection and Möbius transformation are entanglement sensitive*."

5. Discussions and Conclusion

Despite its enormous practical success, many physicists and philosophers alike agree that quantum theory is full of contradictions and paradoxes that are difficult to solve consistently. Even after 90 years, experts still do not agree about what to make of it.

In the meantime, the problem of the formal connection between electrodynamics and wave mechanics has attracted the attention of a number of authors, especially there are some existing proofs on Maxwell-Dirac isomorphism. Here the author reviews two derivations of the Maxwell- Dirac isomorphism by Hans Sallhofer and Volodimir Simulik as well as quaternion language.

While this paper does not conclusively answer the question of whether the Maxwell-Dirac isomorphism and especially its quaternionic formulation can offer a classical description of entanglement, we have mentioned some recent discussions on this topic such the Hopf map and quaternionic Möbius transformations.

This paper was inspired by an old question: Is there a consistent and realistic description of the wave function, both classically and quantum mechanically? It can be expected that the above discussions will shed some light on such an old problem especially in the context

of the physical meaning of the quantum wave function. This is reserved for further investigations.[24]

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A Derivation of Fluidic Maxwell-Proca Equations for Electrodynamics of Superconductors and Its Implication to Chiral Cosmology Model

Victor Christianto[1*], Florentin Smarandache[2] & Yunita Umniyati[3]

[1]Malang Institute of Agriculture (IPM), Malang, Indonesia. [2]Dept. of Math. Sci., Univ. of New Mexico, Gallup, USA
[3]Dept. Mechatronics, Swiss-German University, Indonesia

*Correspondence:
Victor Christianto, Malang Institute of Agriculture (IPM), Malang, Indonesia.
Email: victorchristianto@gmail.com

Abstract

Mario Liu described a hydrodynamic Maxwell equations [3] and, also discussed potential implications of these new approaches to superconductors which were made after Tajmar's paper [4]. In this paper, we present for the first time a derivation of *fluidic* Maxwell-Proca equations. The name of *fluidic*

Maxwell-Proca is proposed because the equations were based on modifying Maxwell-Proca and Hirsch's theory of electrodynamics of superconductor. It is hoped that this paper may stimulate further investigations and experiments in superconductor. It may be expected to have some impact to cosmology modeling too, for instance we consider a hypothetical argument that photon mass can be origin of gravitation. Then, after combining with the so-called chiral modification of Maxwell equations (after Spröessig), then we consider chiral Maxwell-Proca equations as possible alternative of gravitation theory. Such a hypothesis has never considered in literature to the best of our knowledge.

Keywords: Hirsch theory, London equations, hydrodynamics Maxwell equations, Proca equations, electrodynamics, superconductor, chiral medium, chiral gravitation theory.

1. Introduction

According to J.E. Hirsch, from the outset of superconductivity research it was assumed that no electrostatic fields could exist inside superconductors and this assumption was incorporated into conventional London electrodynamics [2]. Hirsch suggests that there are difficulties with the two London equations. To summarize, London's equations together with Maxwell's equations lead to *unphysical* predictions [1]. Hirsch also proposes a new model for electrodynamics for superconductors [1-2].

In this regard, in a rather old paper, Mario Liu described a hydrodynamic Maxwell equations [3]. While he also discussed potential implications of these new approaches to superconductors, such a discussion of electrodynamics of superconductors is made only after Tajmar's paper.

Therefore, in this paper we present for the first time a derivation of fluidic Maxwell-Proca equations. The name of Maxwell-Proca is proposed because the equations were based on modifying Maxwell-Proca and Hirsch's theory of electrodynamics of superconductor.

Therefore, the aim of the present paper is to propose a version of fluidic Maxwell-Proca model for electrodynamics of superconductor. It is hoped that this paper may stimulate further investigations and experiments in particular for fractal superconductor. It may be expected to have some impact to cosmology modeling too, which will be discussed in the last section.

2. Hirsch's proposed revision of London's equations

According to J.E. Hirsch, from the outset of superconductivity research it was assumed that no electrostatic fields could exist inside superconductors and this assumption was incorporated into conventional London electrodynamics.[2] Hirsch suggests that there are difficulties with the two London equations. Therefore he concludes that London's equations together with Maxwell's equations lead to *unphysical* predictions.[1] However he still uses four- vectors J and A according to Maxwell's equations:

$$\Box^2 A = -\frac{4\pi}{c} J, \tag{1}$$

and

$$J - J_0 = -\frac{c}{4\pi\lambda_L^2}(A - A_0). \tag{2}$$

Therefore, Hirsch proposes a new fundamental equation for electrodynamics for superconductors as follows: [1]

$$\Box^2 (A - A_0) = \frac{1}{\lambda_L^2}(A - A_0), \tag{3a}$$

where

- London penetration depth λ_L is defined as follows:[2]

$$\frac{1}{\lambda_L^2} = \frac{4\pi n_s e^2}{m_e c^2}, \tag{3b}$$

- And d'Alembertian operator is defined as: [1]

$$\Box^2 = \nabla^2 - \frac{1}{c^2}\frac{\partial^2}{\partial_t^2} \tag{3c}$$

Then he proposes the following equations: [1]

$$\Box^2(F - F_0) = \frac{1}{\lambda_L^2}(F - F_0), \tag{4}$$

and

$$\Box^2(J - J_0) = \frac{1}{\lambda_L^2}(J - J_0), \tag{5}$$

where F is the usual electromagnetic field tensor and F_0 is the field tensor with entries $\vec{E}_0$ and 0 from $\vec{E}$ and $\vec{B}$ respectively when expressed in the reference frame at rest with respect to the ions.

Proca equations can be considered as an extension of Maxwell equations, and they have been derived in various ways, see for instance [4, 6, 7]. It can be shown that Proca equations can be derived from first principles [6], and also that Proca equations may have link with Klein-Gordon equation [7]. However, in this paper we will not attempt to re-derive Proca equations. Instead, I will use Proca equations as described in [6].

In the meantime, it is known that Proca equations can also be used to describe electrodynamics of superconductors, see [4]-[8]. The difference between Proca and Maxwell equations is that Maxwell equations and Lagrangian are based on the hypothesis that the photon has zero mass, but the Proca's Lagrangian is obtained by adding mass term to Maxwell's Lagrangian.[17] Therefore, the Proca equation can be written as follows:[17]

$$\partial_\mu F^{\mu\nu} + m_\gamma{}^2 A_\nu = \frac{4\pi}{c} J^\nu, \tag{6a}$$

where $m_\gamma = \frac{\omega}{c}$ is the inverse of the Compton wavelength associated with photon mass. [17] In terms of the vector potentials, equation (6a) can be written as [17]:

$$(\Box + m_\gamma) A_\mu = \frac{4\pi}{c} J_\mu. \tag{6b}$$

Similarly, according to Kruglov [15] the Proca equation for a free particle processing the mass m can be written as follows:

$$\partial_\nu \varphi_{\mu\nu}(x) + m^2 \varphi_\mu(x) = 0, \tag{7}$$

Now, the similarity between equations (1) and (6b) are remarkable with exception that equation (1) is in quadratic form. Therefore we propose to consider a modified form of Hirsch's model as follows:

$$(\Box^2 - m_\gamma^2)(F - F_0) = \frac{1}{\lambda_L^2}(F - F_0), \tag{8a}$$

and

$$(\Box^2 - m_\gamma^2)(J - J_0) = \frac{1}{\lambda_L^2}(J - J_0). \tag{8b}$$

The relevance of the proposed new equations in lieu of (4)-(5) should be verified by experiments with superconductors [16]. For convenience, the equations (8a)-(8b) can be given a name: Maxwell-Proca-Hirsch equations.

3. Fluidic Maxwell-Proca Equations

In this regard, in a rather old paper, Mario Liu described a hydrodynamic Maxwell equations.[3] While he also discussed potential implications of these new approaches to superconductors, such a discussion of electrodynamics of superconductors is made only after Tajmar's paper. Therefore, in this section we present for the first time a derivation of *fluidic* Maxwell-Proca equations.

According to Blackledge, Proca equations can be written as follows [7]:

$$\nabla \cdot \vec{E} = \frac{\rho}{\varepsilon_0} - \kappa^2 \phi, \tag{9}$$

$$\nabla \cdot \vec{B} = 0, \tag{10}$$

$$\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}, \tag{11}$$

where:

$$\nabla \times \vec{B} = \mu_0 j + \varepsilon_0 \mu_0 \frac{\partial \vec{E}}{\partial t} + \kappa^2 \vec{A}, \tag{12}$$

$$\nabla \phi = -\frac{\partial \vec{A}}{\partial t} - \vec{E}, \tag{13}$$

$$\vec{B} = \nabla \times \vec{A}, \tag{14}$$

$$\kappa = \frac{mc_0}{\hbar}. \tag{15}$$

Therefore, by using the definitions in equations (9)-(12), and by comparing with hydrodynamic Maxwell equations of Liu [3, eq. 2], now we can arrive at fluidic Maxwell-Proca equations, as follows:

$$\nabla \cdot \vec{E} = \frac{\rho}{\varepsilon_0} - \kappa^2 \phi, \tag{16}$$

where:

$$\nabla \cdot \vec{B} = 0, \tag{17}$$

$$\dot{B} = -\nabla \times E - \nabla \times \left(\hat{\beta} \nabla \times H_0 \right), \tag{18}$$

$$\varepsilon_0 \mu_0 \dot{E} = \nabla \times B - \mu_0 j - \kappa^2 A - \left(\hat{\sigma} E_0 + \rho_e v + \hat{\gamma} \nabla T \right) - \nabla \times \left(\hat{a} \nabla \times E_0 \right), \tag{19}$$

$$\nabla \phi = -\frac{\partial \vec{A}}{\partial t} - \vec{E}, \tag{20}$$

$$\vec{B} = \nabla \times \vec{A}, \tag{21}$$

$$\kappa = \frac{mc_0}{\hbar}. \tag{22}$$

Since according to Blackledge, the Proca equations can be viewed as a unified wavefield model of electromagnetic phenomena [7], therefore we can also regard the fluidic Maxwell-Proca equations as a unified wavefield model for electrodynamics of superconductor.

Now, having defined fluidic Maxwell-Proca equations, we are ready to write down fluidic Maxwell-Proca-Hirsch equations using the same definition, as follows:

$$(\Box_\alpha^2 - \kappa^2)(F' - F_0') = \frac{1}{\lambda_L^2}(F' - F_0'), \tag{23}$$

And

$$(\Box_\alpha^2 - \kappa^2)(J - J_0) = \frac{1}{\lambda_L^2}(J - J_0), \tag{24}$$

where

$$\Box_\alpha^2 = \nabla^{\alpha 2} - \frac{1}{c^2}\frac{\partial^{\alpha 2}}{\partial_t^{\alpha 2}}. \tag{25}$$

As far as we know, the above *fluidic* Maxwell-Proca equations have never been presented elsewhere before. Provided the above equations can be verified with experiments, they can be used to describe electrodynamics of superconductors.

As a last note, it seems interesting to remark here that Kruglov [15] has derived a square-root of Proca equations as a possible model for hadron mass spectrum, therefore perhaps equations (23)-(25) may be *factorized* too to find out a model for hadron masses. Nonetheless, we leave this problem for future investigations.

4. Towards Chiral Cosmology model

The Maxwell-Proca electrodynamics corresponding to a finite photon mass causes a substantial change of the Maxwell stress tensor and, under certain circumstances, may cause the electromagnetic stresses to act effectively as "*negative pressure*". In a recent paper, Ryutov, Budker, Flambaum suggest that such a negative pressure imitates gravitational pull, and may produce effect similar to gravitation. In the meantime, there are other papers by Longo, Shamir etc. discussing observations indicating handedness of spiral galaxies, which seem to suggest chiral medium at large scale. However, so far there is no derivation of Maxwell-Proca equations in chiral medium.

In a recent paper, Ryutov, Budker, Flambaum suggest that Maxwell-Proca equations may induce a negative pressure imitates gravitational pull, and may produce effect similar to gravitation.[18]

In the meantime, there are other papers by Longo, Shamir etc. discussing observations indicating handedness of spiral galaxies, which seem to suggest chiral medium at large scale. As Shamir reported:

> "A morphological feature of spiral galaxies that can be easily identified by the human eye is the handedness—some spiral galaxies spin clockwise, while other spiral galaxies rotate counterclockwise. Previous studies suggest large-scale asymmetry between the number of galaxies that rotate clockwise and the number of galaxies that rotate counterclockwise, and a large-scale correlation between the galaxy handedness and other characteristics can indicate an asymmetry at a cosmological scale."[24]

However, so far there is no derivation of Maxwell-Proca equations in chiral medium. Therefore, inspired by Ryutov et al.'s paper, in this paper, we present for the first time a possibility to extend Maxwell-Proca-type equations to chiral medium, which may be able to explain origin of handedness of spiral galaxies as reported by M. Longo et al.[23. 24. 24a]

The present paper is intended to be a follow-up paper of our preceding paper, reviewing Shpenkov's interpretation of classical wave equation and its role to explain periodic table of elements and other phenomena [11][13][22].

5. Maxwell-Proca Equations in Chiral Medium

It shall be noted, that the relations between flux densities and the electric and magnetic fields depend on the material. It is well-known that for instance all organic materials contain carbon and realize in this way some kind of optical activity. Therefore, Lord Kelvin introduced the notion of the chirality measure of a medium. This coefficient expresses the optical activity of the underlying material. The correspondent constitutive laws are the following:[19]

$$D = \varepsilon E + \varepsilon\beta \text{ rot } E \text{ (Drude-Born-Feodorov laws)}, \quad (26)$$

$$B = \mu H + \mu\beta \text{ rot } H \quad (27)$$

where e = E(t, x) is the electric permittivity, j = p(t, x) is the magnetic permeability and the coefficient β describes the *chirality measure* of the material.[2]

Now, since we want to obtain Maxwell-Proca equations in chiral medium, then eq. (12) should be replaced with eq. (26). But such a hypothetical assertion should be investigated in more precise way.

Since according to Blackledge, the Proca equations can be viewed as a unified wavefield model of electromagnetic phenomena [7], then we can also regard the Maxwell-Proca equations in chiral medium as a further generalization of his *unified wavefield picture* into the realm of superconductors and may be also in cosmology modeling too.

6. Conclusion

One of our aims with the present paper is to propose a combined version of London-Proca- Hirsch model for electrodynamics of superconductor. Considering that Proca equations may be used to

explain electrodynamics in superconductor, the proposed fluidic London-Proca equations may be able to describe electromagnetic of superconductors. It is hoped that this paper may stimulate further investigations and experiments in particular for superconductors. It may be expected to have some impact to cosmology modeling too.

Another purpose is to submit a new model of gravitation based on a recent paper by Ryutov, Budker, Flambaum, who suggest that Maxwell-Proca equations may induce a negative pressure imitates gravitational pull, and may produce effect similar to gravitation. In the meantime, there are other papers by Longo, Shamir etc. discussing observations indicating handedness of spiral galaxies, which seem to suggest chiral medium at large scale (as we know, there are recent findings on carbon molecules from the outer space or interstellar medium too).

However, so far there is no derivation of Maxwell-Proca equations in chiral medium. In this paper, we propose Maxwell-Proca-type equations in chiral medium, which may also explain (albeit hypothetically) origin of handedness of spiral galaxies as reported by M. Longo et al.

It may be expected that one can describe handedness of spiral galaxies by chiral Maxwell-Proca equations. This would need more investigations, both theoretically and empirically.

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Cellular Automata Representation of Submicroscopic Physics

Victor Christianto[1*], Volodymyr Krasnoholovets[2] & Florentin Smarandache[3]

[1]Malang Institute of Agriculture (IPM), Malang, Indonesia [2]Institute of Physics, Natl. Acad. Sci., Ukraine
[3]Dept. of Math. Sci., Univ. of New Mexico, Gallup, USA

*Correspondence:
Victor Christianto, Malang Institute of Agriculture (IPM), Malang, Indonesia.
Email: victorchristianto@gmail.com

Abstract

Krasnoholovets theorized that the microworld is constituted as a *tessellation* of primary topological balls. The tessellattice becomes the origin of a submicrospic mechanics in which a quantum system is subdivided to two subsystems: the particle and its inerton cloud, which appears due to the interaction of the moving particle with oncoming cells of the tessellattice. The particle and its inerton cloud periodically change the momentum and hence move like a wave. The new approach allows us to correlate the Klein-Gordon equation with the deformation coat that is formed in the tessellatice

around the particle. The submicroscopic approach shows that the source of any type of wave movements including the Klein-Gordon, Schrödinger, and classical wave equations is hidden in the tessellattice and its basic exciations – inertons, carriers of mass and inert properties of matter.

Keywords: Schrödinger, Klein-Gordon, classical wave equation, periodic table, molecule, cellular automata, submicroscopic.

1. Introduction

Elze [1] wrote about possible re-interpretation of quantum mechnics (QM) starting from classical automata principles. This is surely a fresh approach to QM, initiated by some authors including Gerard 't Hooft [3]. In the mean time, in a series of papers Shpenkov [2, 3-14] suggested that the spherical solution of Schrödinger's equation says nothing about the structure of molecules. According to Shpenkov [2, 3-14], the classical wave equation is able to derive a periodic table of elements which is close to Mendeleyev's periodic table and also other phenomena related to the structure of molecules.

However, the Schrödinger equation is a quantum equation that describes the motion of the appropriate particle-wave since all quantum objects manifest charecteristics of both particles and waves. Considering Shpenkov's results, one can ask: *why do the particle's characteristics dissapear and what exactly is the subject of purely wave behaviour in a quantum system*?

Recently, Krasnoholovets has developed a submicroscopic concept in which the motion of a canonical particle occurs in physical space constructed as a cellular structure named the tessellattice(see, e.g. Ref. [15]).

In this paper, we carry out studies of the Schrödinger equation and classical wave equation and show how they both are related to the idea of tessellatice. The Appendix contains a more detailed proof on how "space" has the form of acoustic/sound wave.

2. Correspondence betwwen Classical Wave & Quantum Mechanics

A connection between classical and quantum mechanics has been studied at least by several researchers (see e.g. Refs. [26-28]). Ward and Volkmer [29] discussed a relation between the classical electromagnetic wave equation and Schrödinger equation. They derived the Schrödinger equation based on the electromagnetic wave equation and Einstein's special theory of relativity. They began with electromagnetic wave equation in one-dimensional case:

$$\frac{\partial^2 E}{\partial x^2} - \frac{1}{c^2}\frac{\partial^2 E}{\partial t^2} = 0 \tag{13}$$

This equation is satisfied by plane wave solution:

$$E(x, t) = E_0 e^{j(kx-\omega t)}, \tag{14}$$

Where k = $2\pi/\lambda$ and $\omega = 2\pi v$ are the spatial and temporal frequencies, respectively. Substituting equation (14) into (13), then we obtain

$$\left(\frac{\partial^2}{\partial x^2} - \frac{1}{c^2}\frac{\partial^2}{\partial t^2}\right) E_0 e^{j(kx-\omega t)} = 0, \tag{15}$$

or

$$\left(k^2 - \frac{\omega^2}{c^2}\right) E_0 e^{j(kx-\omega t)} = 0, \tag{16}$$

which arrives us to a dispersion relationship for light in free space: k= ω/c . This is similar to the wave number k in eq. (8).

Then, recalling from Einstein and Compton that the energy of a photon is $\varepsilon = h\nu = \hbar\omega$ and the momentum of a photon is $p = h/\lambda = \hbar k$, which allows us to rewrite eq. (14) using these relations:

$$E(x, t) = E_0 e^{\frac{i}{\hbar}(px-\varepsilon t)}. \tag{17}$$

Substituting expression (17) into eq. (13) we find

$$-\frac{1}{\hbar^2}\left(p^2-\frac{\varepsilon^2}{c^2}\right)E_0 e^{\frac{i}{\hbar}(px-\varepsilon t)}=0, \tag{18}$$

which results in the relativistic total energy of a particle with zero rest mass

$$\varepsilon^2 = p^2c^2 . \tag{19}$$

Following de Broglie, we may write the total relativistic energy for a particle with non-zero rest mass

$$\varepsilon^2 = p^2c^2 + m_0^2c^4. \tag{20}$$

Inserting expression (20) into eq. (18), it is straightforward from (15) that we get

$$\left(\nabla^2-\frac{m_0^2c^2}{\hbar^2}\right)\Psi=\frac{1}{c^2}\frac{\partial^2\Psi}{\partial t^2}, \tag{21}$$

which is the Klein-Gordon equation [30, 31] for a free particle [29]. Now we want to obtain Schrödinger equation, which is non-relativistic case of eq. (21). The first step is to approximate $\varepsilon^2 = p^2c^2 + m_0^2c^4$ as follows

$$\varepsilon = m_0c^2\sqrt{1+\frac{p^2}{m_0^2c^2}} \approx m_0c^2+\frac{p^2}{2m_0} \approx m_0c^2+\Im . \tag{22}$$

After some approximation steps, Ward and Volkmer [29] arrived at the Schrödinger equation

$$-\frac{\hbar^2}{2m}\nabla^2\phi = i\hbar\frac{\partial\phi}{\partial t}, \tag{23}$$

where the non-relativistic wave function ϕ is also constrained to the condition that it be normalisable to unit probability.

In the meantime, Hilbert and Batelaan [32] explored equivalence between the quantum and acoustic system. A simple physical system was discussed, which mirrorred the quantum mechanical infinite square well with a central delta well potential. They find that the analytic

solution to the quantum system exhibits level splitting, as does the acoustic system. They compare the acoustic resonances in a closed tube and the quantum mechanical eigen-frequencies of an infinite square well and showed that the acoustic displacement standing wave is

$$\xi(x) = \xi_{\max} \sin\left(n\pi x / (2a)\right) \tag{24}$$

for the *n*-th resonance. Eq. (24) has the same shape as the quantum mechanical wave function.

So we can conclude that there exists formal connection between the classical wave equation and Schrödinger equation, but it still requires some assumptions and approximations. Shpenkov's interpretation of classical wave equation looks as more realistic for atomic and molecular modeling.

3. Cellular Automata Model of Classical Wave Equation

In the previous section, we have argued that Shpenkov's interpretation of classical wave equation looks as more realistic for atomic and molecular modeling. Now we shall outline a cellular automata model of classical wave equation.

But first of all, let us give a few remarks on cellular automata. The term cellular automata cellular automata is plural. Our code examples will simulate just one—a cellular automaton cellular automaton, singular. To simplify our lives, we'll also refer to cellular automata as "CA." Cellular automata make a great first step in building a system of many objects that have varying states over time:

A cellular automaton is a model of a system of "cell" objects with the following characteristics.

- The cells live on a grid grid. (We'll see examples in both one and two dimensions in this chapter, though a cellular automaton can exist in any finite number of dimensions.)
- Each cell has a state. The number of state possibilities is typically finite. The simplest example has the two possibilities of 1 and 0 (otherwise referred to as "on" and "off" or "alive" and "dead").

- Each cell has a neighborhood. This can be defined in any number of ways, but it is typically a list of adjacent cells.[36]

Now consider a set of simple rules that would allow that pattern to create copies of itself on that grid. This is essentially the process of a CA that exhibits behaviour similar to biological reproduction and evolution. (Incidentally, von Neumann's cells had twenty-nine possible states.) Von Neumann's work in self-replication and CA is conceptually similar to what is probably the most famous cellular automaton: the "Game of Life." Perhaps the most significant scientific (and lengthy) work studying cellular automata arrived in 2002: Stephen Wolfram's *A New Kind of Science* (http://www.wolframscience.com/nks/) [36].

A plausible method to describe cellular automata model of wave equation was described for instance by Yang and Young [33]. For the 1D linear wave equation, where c is the wave speed they presented a scheme:

$$\frac{u_i^{n+1} - 2u_i^n + u_i^{n-1}}{(\Delta t)^2} = c^2 \frac{u_{i+1}^n - 2u_i^n + u_{i-1}^n}{(\Delta x)^2}. \tag{25}$$

After some steps eq. (25) can be rewritten in a generic form (by choosing $\Delta t = \Delta x = 1$, $t = \nu$) as follows $u_i^{t+1} + u_i^{t-1} = g(u^t)$, which is reversible under certain conditions. This property comes from the reversibility of the wave equation because it is invariant under the transformation: $t \to -t$.

O'Reilly has shown that the coupled Maxwell-Dirac electrodynamic system can be implemented in an analog cellular-automaton operating within a 3D regular face-centered cubic lattice [34]. The result of this approach can be expressed in terms of a second order wave equation, namely: $s_i^{t+1} = s_i^t + \dot{s}_i^{t+1}$. He concludes that the second order wave equation is arguably one of the simplest possible continuous-valued cellular automata update equations that do anything physically interesting,

though all of electrodynamics can be built of elaborations of this one fundamental interaction.

Thus, cellular approach allows one to construct equations that describe physical systems without using second order equations.

Correspondence with Konrad Zuse's work: from static space to calculating space

To trace the development of physical thoughts in this field, we would like to mention two books. In the late 1970s, Konrad Zuse conceived an essay entitled *Calculating Space*, in which he advocated that physical laws are discrete by nature and that the entire history of our universe is just the output of a giant deterministic CA.[37]

It shall be clear, that we should let go our assumption of static space (Newtonian), nor dynamical space (Einsteinian), toward calculating space (Zusian). In this new model, space itself has a kind of computing capability, hence intelligence, albeit perhaps not the same kind of human intelligence. If such a new proposition can be proved true, then it may open up an array of explanations on many puzzling cosmology questions, such as: why galaxies apparently grow and then move to other directions (for instance, it is known that our Milky Way is moving toward *The Great Attractor*). Such an observed dynamics is very difficult to comprehend in terms of classical picture based on static space (differential equations).

In closing, we would like to quote Zuse's perceptive predictions made forty years ago: "*Incorporation of the concepts of information and the automaton theory in physical observations will become even more critical, as even more use is made of whole numbers, discrete states and the like*."[37]

Nonetheless, we shall also keep in mind Zuse's question: "Is nature digital, analog or hybrid?" It is clear that classical physics is built in analogue way, but it does not mean that Nature is perfectly working

in accordance with that model. That question needs to be investigated in more precise manner. [37, p. 22]

One way to investigate such a discrete model of space is by assuming a tessellattice model of space, as will be discussed in the next section.

4. The Tessellattice as the Source for the Formalism of Conventional Quantum Mechanics

A detailed theory of real physical space was developed by Bounias and Krasnoholovets starting from pure mathematical principles (see e.g. Ref. [35]). A submicroscopic theory of physical processes occurring in real physical space was elaborated by Krasnoholovets in a series of works (see e.g., monograph [15]). Those studies show that our ordinary space is constructed as a mathematical lattice of primary topological balls, which was named a tessellattice.

In the tesselllattice, primary topological balls play the role of cells. This is a physical vacuum, or aether. Matter emerges at local deformations of the tessellattice when a cell (or some cells) changes its volume following a fractal law of transformations. Such a deformation in the tessellattice can be associated with the physical notion of mass.

The motion of a fractal-deformed cell, i.e. a mass particle, is occurred with the fractal decomposition of its mass owing to its interaction with ongoing cells of the tessellattice. This is a further development of Zuse's idea about calculating space because cells can exchange by fractals, which locally change properties of space.

The interaction of matter with space generates a cloud of a new kind of spatial excitations named 'inertons'. This means that "hidden variables" introduced in the past by Louis de Broglie, David Bohm and Jean-Pierre Vigier have acquired a sense of real quasiparticles of space.

Thus in monograph [15] it has been shown that inertons are carriers of a new physical field (the inerton field), which appears as a basic field of the universe. Inertons as quasi-particles of the inerton field

are responsible for quantum mechanical, nuclear and gravitational interactions of matter. Inertons carry mass and also fractal properties of space, i.e. they are real carries of information.

A particle moving in the tessellattice is surrounded with its inerton cloud. The particle actualizes the real motion between ongoing cells, though its inertons emitted when the particle rubs again the tessellattice's cells, migrate as excitations hopping from cell to cell. Such sophisticated motion in which the particle is surrounded with its inerton cloud can easily be compared with the formalism of quantum mechanics because the particle wrapped with its inertons can be projected to the particle's wave ψ-function determined in an abstract phase space. In such a pattern, the overlapping of wave ψ-functions of nearest particles means that the particles' inerton clouds overlap and thus we obtain real carriers of the quantum mechanical interaction, which provide a short-range action between the particles studied.

The particle's de Broglie wavelength λ plays the role of a section in which the moving particle emits its inerton cloud (an odd section) and in the next even section λ these inertons come back to the particle passing the momentum on to it. Inertons emitted by the freely moving particle come back to the particle owing to the elasticity of the tessellattice as such.

How can we write the interaction of a moving particle with its inerton cloud? The interaction can be written between the particle and an ensemble of inertons, which accompany the particle. The ensemble is presented as one integral object, an inerton cloud. The speed v_0 of the particle the particle satisfies the inequality $v_0 << c$. At such presentation, our study is significantly simplified and is reduced to the consideration of a system of two objects: the particle and its cloud of inertons, which the particle periodically emits and adsorbs when moving along its path. In this case the Lagrangian (2.1) is transformed to the following one written in two-dimensional Euclidean space.

$$L = \tfrac{1}{2} m_0 \dot{x}^2 + \tfrac{1}{2} \mu_0 \cdot \left[(\dot{\chi}^{\parallel})^2 + (\dot{\chi}^{\perp})^2 \right] - \frac{2\pi}{T} \sqrt{m_0 \mu_0}\, x \dot{\chi}^{\perp}. \tag{26}$$

In the Lagrangian (26)(2.49) the first term describes the kinetic energy of the particle with the mass m and the velocity $\dot{x}$, which moves along the axis X; the second term depicts the kinetic energy of the whole inerton cloud whose mass is μ_0 and its center-of-mass has the coordinate $X^{\parallel}$ along the particle's path and $X^{\perp}$ is the transverse coordinate; the third term is the interaction energy between the particle and the inerton cloud where $1/T$ is the frequency of their collisions.

By using the substitution

$$\dot{x}^{\perp} = \dot{\tilde{\chi}} + 2\pi \sqrt{m_0 / \mu_0}\, x / T, \tag{27}$$

we carry out a kind of a canonical transformation that leads to the following Lagrangian

$$\tilde{L} = \tfrac{1}{2} m_0 \dot{x}^2 - \tfrac{1}{2} (2\pi / T)^2 m_0 x^2 + \tfrac{1}{2} \mu_0 \cdot \left(\dot{\tilde{\chi}}^2 + (\dot{\chi}^{\parallel})^2 \right). \tag{28}$$

We can see from the effective Lagrangian (28)(2.51) that in such a presentation the particle's behavior is described as a classical harmonic oscillator and the accompanying inerton cloud moves by its own hidden principle (though it does not disturb the particle).

The Hamiltonian function according to the definition

$$H = \sum_i \dot{Q}_i \partial L / \partial \dot{Q}_i - L.$$

In our case the Hamiltonian is

$$H = \dot{x} \partial L / \partial \dot{x} + \dot{\tilde{\chi}} \partial L / \partial \dot{\tilde{\chi}} - \tilde{L} \tag{29}$$

The effective Hamiltonian based on the Lagrangian (28)(2.51) of the oscillating particle in the system of the center-of-mass of the particle and its inerton cloud in the explicit form becomes

$$H = p^2 / (2m_0) + m_0 (2\pi / T)^2 x^2 / 2 \tag{30}$$

Solutions of the equations of motion given by the Hamiltonian (30) are well known for different presentations. In particular, the function (30) allows one to derive the Hamilton-Jacobi equation

$$(\partial S_1 / \partial x)^2 / (2m_0) + m_0 (2\pi / T)^2 x^2 / 2 = E \tag{31}$$

from which we obtain the equation for a shortened action

$$S_1 = \int_{x_0}^{x} p\, dx = \int_{x_0}^{x} \sqrt{2m_0 [E - (2\pi / T)^2 x^2 / 2]}\, dx \tag{32}$$

The function (32)(2.55) enables the solution x as a function of *t* in the form

$$x = \frac{\sqrt{2E / m_0}}{2\pi / T} \sin(2\pi t / T) \tag{33}$$

Now we can calculate the increment ΔS_1 of the action (32)(2.55) of the particle during the period *T*; in terms of the action-angle variables

$$\begin{aligned} \Delta S_1 &= \oint p\, dx = \oint \sqrt{2m_0 \left(E - m_0 (2\pi / T)^2 x^2 \right)}\, dx \\ &= \oint \sqrt{2m_0 \left(E - E \sin^2 (2\pi t / T) \right)} \sqrt{2E / m_0} \cos(2\pi t / T)\, dt \\ &= 2E \int_0^T \cos^2 (2\pi t / T)\, dt = 2E \left(\frac{t}{2} + \frac{\sin(4\pi t / T)}{4(2\pi / T)} \right) \Bigg|_{t=0}^{t=T} = ET. \end{aligned} \tag{34}$$

The final result (34) can be rewritten as follows

$$\Delta S_1 = E \cdot T = E / \nu \tag{35}$$

where the notation $\nu = 1/T$ is entered.

Since the constant *E* is the initial energy of the particle, *i.e.*, $E = \frac{1}{2} m_0 \upsilon_0^2$, the increment of action (35) can also be presented in the form

$$\Delta S_1 = \tfrac{1}{2} m_0 \upsilon_0^2 \cdot T = m_0 \upsilon_0 \cdot \tfrac{1}{2} \upsilon_0 T = m_0 \upsilon_0 \cdot \lambda \tag{36}$$

where the parameter λ is the spatial amplitude of oscillations of the particle along its path.

If we equate the increment of the action ΔS_1 to the Planck constant *h*, we immediately arrive at the two major relationships of quantum mechanics introduced by de Broglie for a particle:

$$E = h\nu, \qquad \lambda = h/(m_0 \upsilon_0). \tag{37}$$

Thus the amplitude of special oscillation of a particle is exactly the particle's de Broglie wavelength.

Having obtained the relationships (37), we can present the complete action for a particle

$$S = S_1 - Et = \int^x p\, dx - Et \tag{38}$$

in two equivalent forms: and

$$S = m_0 \upsilon_0 x - Et \tag{39}$$

and

$$S = h\cdot(x/\lambda - \nu t). \tag{40}$$

The relationships (39), (40) and (37) allow the derivation of the Schrödinger equation. If in a conventional wave equation

$$\Delta\psi - \frac{1}{(\upsilon_0/2)^2}\frac{\partial^2\psi}{\partial t^2} = 0 \tag{41}$$

(where ½v_0 is the average velocity of the particle in the spatial period λ) we insert a wave function, whose phase is based on the action (40),

$$\psi = a\exp\left\{i\,2\pi[x/\lambda - \nu t]\right\}, \tag{42}$$

and set v_0=λ.2v, we get the wave equation in the following presentation:

$$\Delta\psi + \left(2\pi/\lambda\right)^2\psi = 0. \tag{43}$$

Then putting λ=h/p and extracting the momentum p from the function (32) (*i.e.*, p^2=2mE) we finally obtain a conventional time-independent Schrödinger equation

$$\Delta\psi + \frac{2m_0E}{\hbar^2}\psi = 0. \tag{44}$$

Thus, we can see that the moving system of a particle and its inerton cloud obeys the Schrödinger equation.

5. The Deformation Coat of Particle & the Klein-Gordon Equation

As we discussed above, Ward and Volkmer [29] demonstrated the derivation of the Klein-Gordon equation (21) for a mass particle starting from its total relativistic energy $\varepsilon^2=p^2c^2+m_0{}^2c^4$ (20). They also showed that a non-relativistic approximation of the same energy (20) results in the Schrödinger time-dependent equation (23).

Usually the Klein-Gordon equation [30, 31] is applied for the description of an abstract relativistic particle that does not possess spin. However, the submicroscopic concept of physics presented in monograph [15] makes *it possible to relate the Klein-Gordon equation to a real object*, namely, a deformation coat that is developed around the mass particle created in the tessellatice.

In fact the creation a particle means the appearance of a local deformation, i.e. a volumetric fractal deformation of the appropriate cell of the tesselllatice. The local deformation must induce a tension state in ambient cells, which may extend only to a definite radius R. So behind the radius R, the tessellattice does not have any distortion, it is found here in a degenerate state.

The study [15] shows that in the microworld such fundamental physical parameters as mass and charge vary at the motion. Namely, in a section (the even section) equal to the particle's de Broglie wavelength λ the mass m is transferred to a tension ξ and the charge e changes to the magnetic monopole g. In the odd section λ the mass and charge are restored. The same happened with cells that form the particle's deformation coat. When the particle is moving, it pulls its deformation coat as well, i.e. ambient cells adjust to state of the particle. In the deformation coat the state of cells oscillates between the tension ξ

and mass m. A collective oscillating mode of the deformation coat is specified by the energy [15] $E=\hbar\omega$, which in turn equals the total energy of the particle mc^2.

The discussed oscillations can be described by a plane wave mode $E(x,t)=E_0e^{i(kx-\varepsilon t)}$ (17). Then following the arguments (17) – (21), we immediately derive the Klein-Gordon equation (21). Note that in our case the particle that obeys the Klein-Gordon equation is the deformation coat that accompanies the moving particle. This deformation coat is specified with the radius equal to the particle's Compton wavelength [15] (see p. 57).

If the speed v of a particle satisfies the inequality $v<<c$, we following reasoning (22) and (23) will arrive at the Schrödinger equation (23).

6. Conclusion

We have reviewed a plausible cellular automaton molecular model for classical wave equation, as an alternative to Cellular automaton quantum mechanics (by Elze, Gerard 't Hooft etc).

Then we have considered the submicroscopic concept that allows one to easily derive the Schrödinger and Klein-Gordon equations starting from first submicroscopic principles. It is interesting that for the first time we now can identify the Klein-Gordon equation with a real object that is described by this equation – it is the particle's deformation coat that is induced in the tessellattice at around the appropriate created canonical particle.

The submicroscopic concept, which is based on space constituted as the tessellattice of primary topological balls, introduces a new physical field, namely the inerton field, which appears as a fundamental field of the universe. Inertons emerge at any motion of particles; in particular, they arise in atoms and around owing to uninterrupted motion of electrons, nuclei and nucleons.

Thus the motion of a quantum system is characterized by its separation to two joined subsystems: the particle itself and its inerton cloud. Their oscillation dynamics exhibits obvious features of the wave motion. Although the deformation coat that accompanies the moving particle behaves in a special way, it is described by the Klein-Gordon equation, which also manifests the wave properties.

Our analysis shows that oscillations of inertons are present in any movement of a material object. Inertons clearly demonstrate wave behavior. This means that inerton oscillations appear in atoms and molecules. Hence inerton oscillations justify Shpenkov's model [4–14], which applies a classical wave equation of sound to atoms and molecules: the wave function Ψ used by Shpenkov describes oscillations of an inerton field and the location of the corresponding nodes in the oscillating wave studied.

Thus, quantum mechanical models, cellular automata, and a cellular automaton molecular model that uses a wave equation can be covered by studies originated from the tessellattice and the submicroscopic behavior of quantum systems, which involves an inerton field that binds canonical particles with the tessellattice and between themselves.

Nonetheless, there remains many questions to ponder, for example: whether the notion of cellular automata corresponds neatly to Zuse's calculating space hypothesis [37], and whether the latter in turn leads to cellular intelligence (see for instance [37a]). Therefore, further investigations in this direction are recommended, which will shed light on the cornerstones of the microworld.

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Concluding Remark

If we consider that this book suggests that the reality can be modelled in quite simple but convincing way, especially the nature of gravitation, via correspondence between cosmology phenomena and low temperature physics, yes it feels almost like miracle for us.

As always we are sure that such a miracle in finding realistic description of physics, cannot be manufactured. As this popular song lyrics goes:

You can't manufacture a miracle
The silence was pitiful, that day
And love is getting too cynical
Passion's just physical, these days[25]

What we can say, is that such a comprehension is even more mysterious, as Wigner once argue: that whether mathematics can be useful to describe physical nature, is itself another question.

After all, we are just humble truths-seeker, because after all this entire Cosmos belongs to God Almighty, and no one else:

25 Song writer: Guy Antony Chambers / Robert Peter Williams. Lirik Something Beautiful © BMG Rights Management, Universal Music Publishing Group

The heavens declare the glory of God;
And the firmament[a] shows [b] His handiwork.
2 Day unto day utters speech,
And night unto night reveals knowledge.
3 There is no speech nor language
Where their voice is not heard. (Psalm 19, NKJV)

Soli Deo Gloria

Medio April 2022, Passover Day

Victor Christianto

Personal website: www.SecondComingInstitute.com

Link at academia: http://sttsati.academia.edu/VChristianto

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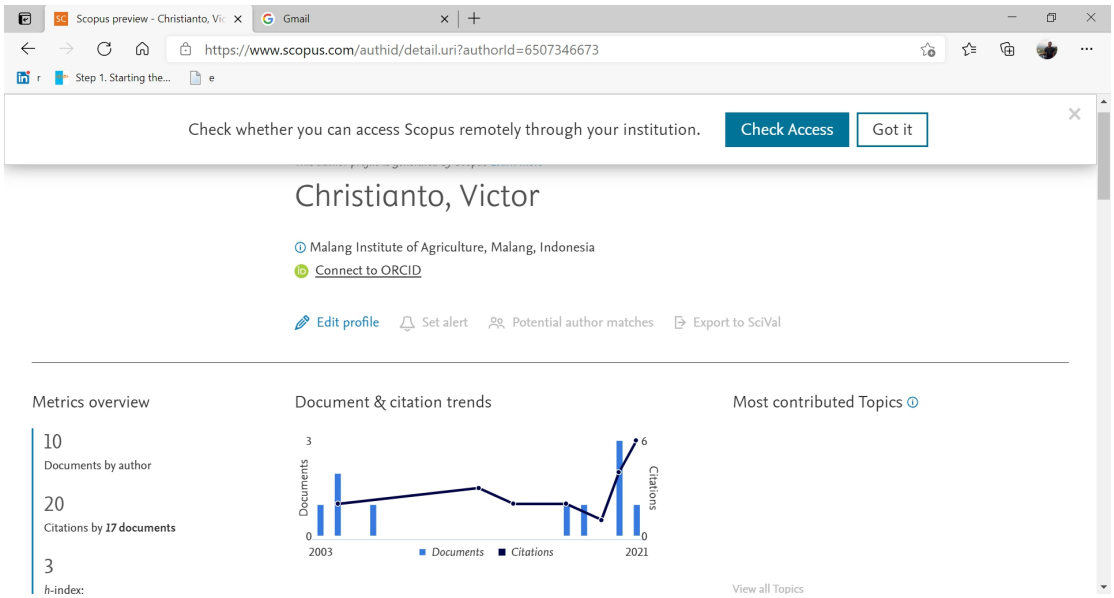

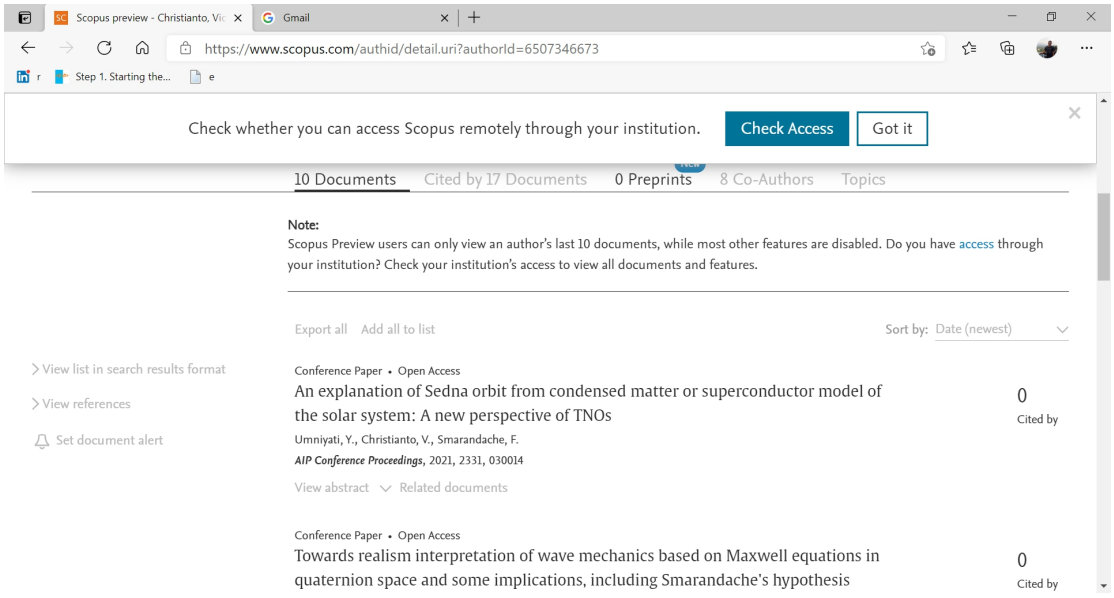

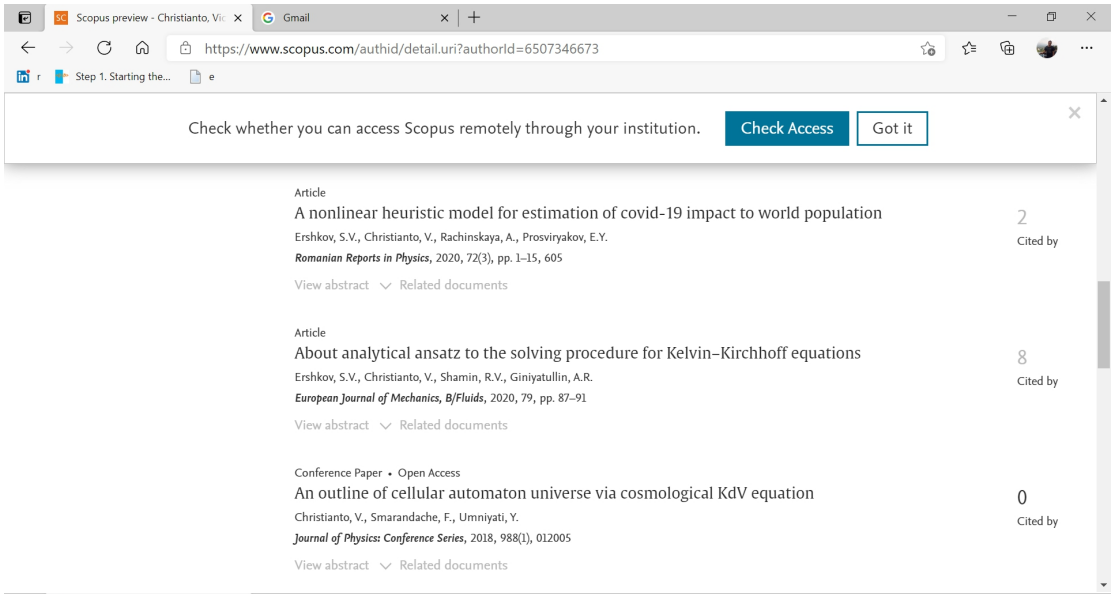

Article

A nonlinear heuristic model for estimation of covid-19 impact to world population

Ershkov, S.V., Christianto, V., Rachinskaya, A., Prosviryakov, E.Y.

Romanian Reports in Physics, 2020, 72(3), pp. 1–15, 605

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About analytical ansatz to the solving procedure for Kelvin–Kirchhoff equations

Ershkov, S.V., Christianto, V., Shamin, R.V., Giniyatullin, A.R.

European Journal of Mechanics, B/Fluids, 2020, 79, pp. 87–91

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Christianto, V., Smarandache, F., Umniyati, Y.

Journal of Physics: Conference Series, 2018, 988(1), 012005

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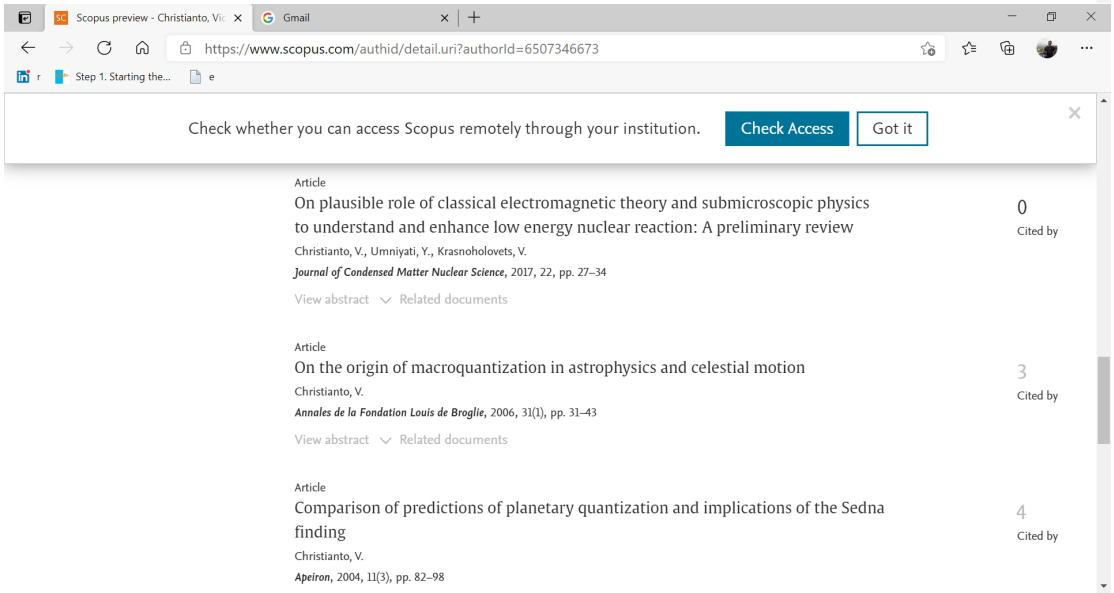

Article

On plausible role of classical electromagnetic theory and submicroscopic physics to understand and enhance low energy nuclear reaction: A preliminary review

Christianto, V., Umniyati, Y., Krasnoholovets, V.

Journal of Condensed Matter Nuclear Science, 2017, 22, pp. 27–34

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Christianto, V.

Annales de la Fondation Louis de Broglie, 2006, 31(1), pp. 31–43

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Christianto, V.

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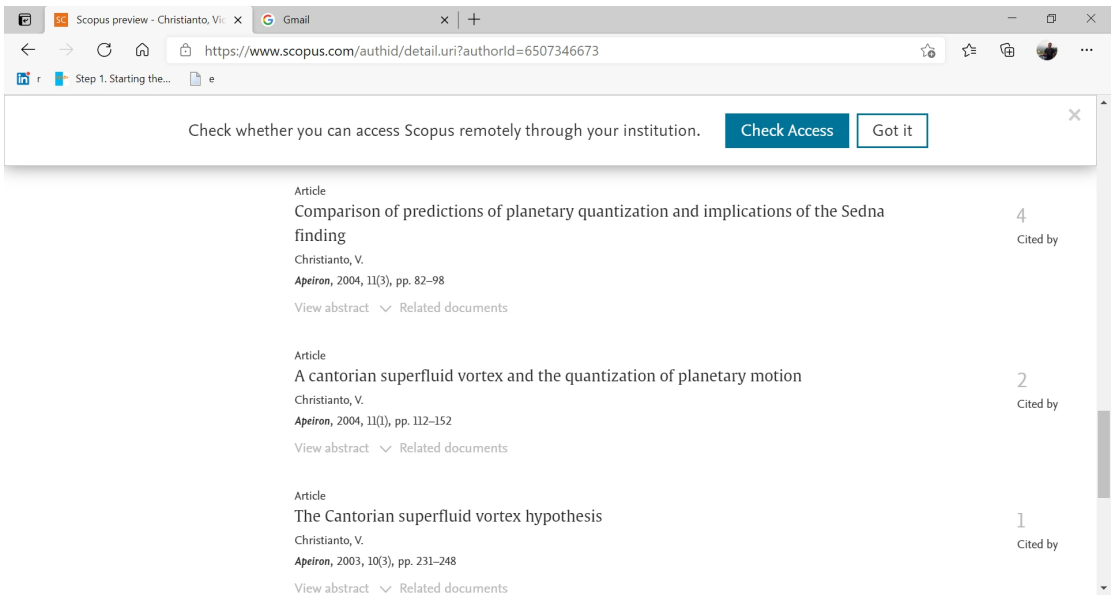

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Apeiron, 2003, 10(3), pp. 231–248

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Short biography of Professor Florentin Smarandache, PhD.

(postdoc in mathematics and sciences)

Florentin Smarandache is a professor of mathematics at the University of New Mexico, United States. He got his MSc in Mathematics and Computer Science from the University of Craiova, Romania, PhD in Mathematics from the State University of Kishinev, and Postdoctoral in Applied Mathematics from Okayama University of Sciences, Japan, and The Guangdong University of Technology, Guangzhou, China. ₩

He is the founder of neutrosophy (generalization of dialectics), neutrosophic set, logic, probability and statistics since 1995 and has published hundreds of papers and books on neutrosophic physics, superluminal and instantaneous physics, unmatter, quantum paradoxes, absolute theory of relativity, redshift and blueshift due to the medium gradient and refraction index besides the Doppler effect, paradoxism, outerart, neutrosophy as a new branch of philosophy, Law of Included Multiple-Middle, multispace and multistructure, hypersoft set, SuperHyperGraph, SuperHyperAlgebra, Neutrosophic SuperHyperAlgebra, degree of dependence and independence between neutrosophic components, refined neutrosophic set, neutrosophic over-under-off-set, plithogenic set / logic / probability / statistics, neutrosophic triplet and duplet structures, quadruple neutrosophic structures, extension of algebraic structures to NeutroAlgebras and AntiAlgebras, NeutroGeometry & AntiGeometry, Dezert-Smarandache Theory and so on to many peer-reviewed international journals and many books and he presented papers and plenary lectures to many international conferences around the world.

In addition, he published many books of poetry, dramas, children' stories, translations, essays, a novel, folklore collections, traveling memories, and art albums [http://fs.unm.edu/FlorentinSmarandache.htm].