On Post-Empiricism doctrine and Neutrosophic way of doing science: From Principle of Parsimony to going beyond Popper and Kuhn

Victor Christianto* Florentin Smarandache**

*Malang Institute of Agriculture (IPM), Indonesia. Email: victorchristianto@gmail.com
**Mathematics, Physical and Natural Sciences Division, University of New Mexico, Gallup, NM 87301, USA. Email: smarand@unm.edu.

Abstract

Despite majority of theoretical physicists begin to accept the *post-empiricism doctrine*, still few physicists and mathematicians alike don't agree with such a doctrine, partly because it is against Popper's criterion of falsifiability for any theory in physics and other sciences. And partly because criteria like beauty or elegance seem rather subjective for a theory to be accepted as "physics'. Physicists like Peter Woit and Sabine Hossenfelder have written books on this topics [10-11]. In this article, we don't repeat those arguments, instead we only argue in favor of *principle of parsimony*, or that Nature seems to prefer least action, or least energy either in modeling complexity, assumptions and free parameters involved, and minimizing computational entropy required before getting any meaningful results. Therefore, we arrive at conclusion that one shall find a balance among some criteria, of which we may call this point "*Ockham optimality point*.." We hope that this article points out to new hints to the problems of theoretical physics, as Woit and Hossenfelder lamented.

Keywords: William Ockham, Sabine Hossenfelder, Peter Woit, principle of parsimony, Neutrosophic Logic, Popperian epistemology, Ockham optimality point, mathematical physics.

Introduction

The present status of theoretical physics seems to face a dark cloud in the sky, because the highly acclaimed theories such as loop quantum gravity, superstring or M-theories cannot be verified by experiments, at least not within the present limit of measurement devices. Therefore, some

theoreticians like Dawid began to argue in favor of releasing the verifiability criterion for any theory to be accepted as working physics theories.[12] That kind of post-empiricism doctrine, as it is called, is supposed to supersede the conventional Popperian epistemology, which include falsifiability for any theory before it can be accepted.

However, some prominent cosmologists and theoreticians disagree with that doctrine. Attempts to exempt speculative theories of the Universe from experimental verification *undermine science*, argue George Ellis and Joe Silk. [1] They also wrote:

> "Faced with difficulties in applying fundamental theories to the observed Universe, some researchers called for a change in how theoretical physics is done. They began to argue — explicitly — that if a theory is sufficiently elegant and explanatory, it need not be tested experimentally, breaking with centuries of philosophical tradition of defining scientific knowledge as empirical. We disagree."

But, despite some physicists have emphasized on the virtue of empirical test and conceptual simplicity, such criteria appear not so clear to be applied on daily basis.

Therefore, there is a need to apply such criteria on simplicity or principle of parsimony in a more operational way.

Intuition and Neutrosophic way of doing science

In a recent article, we argue on the role of intuition in doing science, apart of the so-called Dirac's dictum that to *find new physics, we shall find new mathematics.* In our proposed "Neutrosophic way", it is intuition (or in German, *einfuhlung*) that should be given more emphasis.

Any effort to depict or map life or reality as an abstract substance needs to use real life or concrete experience to arrive at such an understanding. To choose the concrete experience and to connect it with the abstract domain, one needs intuition.

As this work emphasizes [3]:

> "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."[3]

Therefore, to reply to the question concerning rectifying the problem of overemphasizing rationality in mathematics and beyond, McGilchrist's concept and Conceptual Linguistics theory can shed light.[2][4] From Neutrosophic Logic viewpoint, this article recommends that a combination

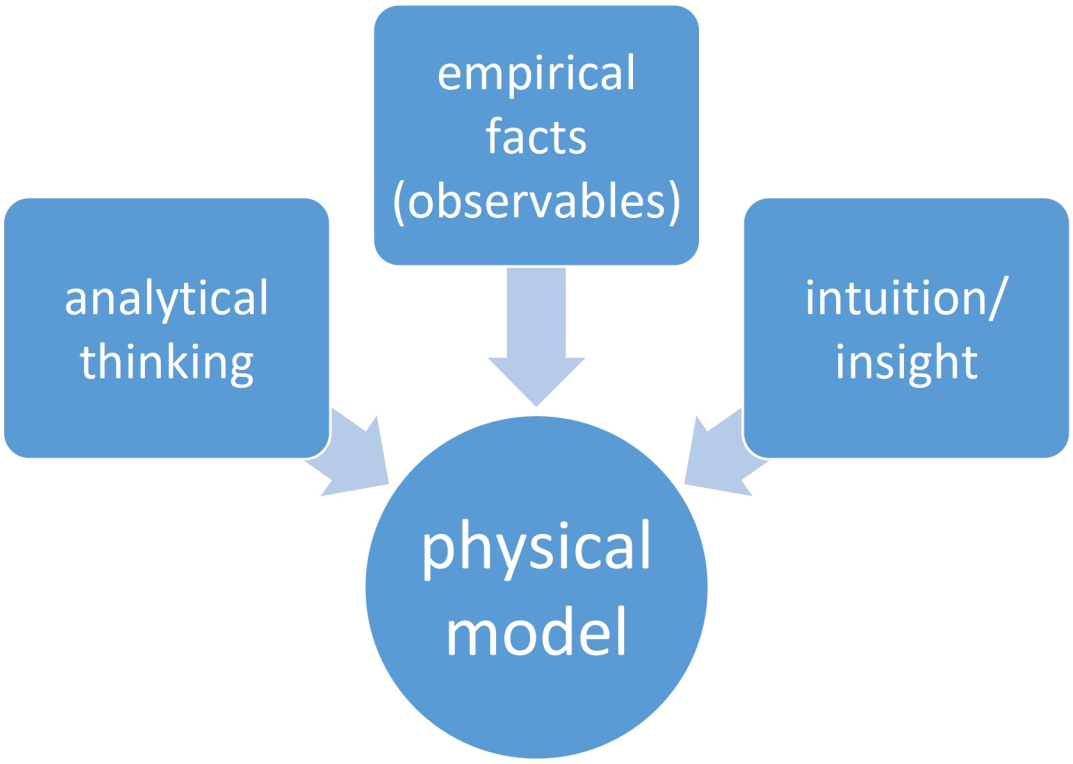

Diagram 1. The role of intuition, analytical thinking, and empirical facts

of both the intuitive aspect of the right hemisphere and the analytical or logical thinking processes of the human's left brain will be more adequate

in creating a holistic approach. The article proposes a term: intuilytics to capture the essence of the Balanced Brain [3].

With regards to scientific discovery processes, the proposed scheme as outlined above hint toward a slightly different approach compared to Popperian method or Kuhnian concept of paradigm change. Therefore, in addition to the role of intuition and analytics/rational thinking, we need empirical facts as the basis of model building. To emphasize those triplet, let us put into Diagram 1 above.

A few remarks on rationale

Some readers may ask at this point, the diagram 1 above looks too simplifying for a method, doesn't it? Yes, it is true, but let us consider that even for well-known mathematicians such as G. Polya, something more than mathematics methods, something deeper like curiosity etc are needed to solve a real-world problem. As he wrote in his book: "How to solve it," as follows: "Behind the desire to solve this or that problem that confers no material advantage, there may be a deeper curiosity, a desire to understand the ways and means, the motives and procedures, of solution." Other mathematicians like Jacques Hadamard also wrote on psychology of invention in the mathematical field.[1]

[1] Special thanks to Dennis P. Allen, Jr., for reference to Polya, Hadamard and also his on-going works on Neo-Newtonian Mechanics and Gutschian Mechanics.

So what would such a discussion bring to us? May be if we follow more on our heart and our guts, we may someday will come up with a set of original approaches to mechanics or gravitation theory, see for example: *Neo-Newtonian Mechanics* or *Gutschian Mechanics* by mathematician fellow, Dennis P. Allen, Jr., et al. [22][23].

Some criteria with respect to Principle of Parsimony and Ockham optimality

As we argued in a recent paper [5-6], this deep problem in philosophy of science can be viewed as another case that calls for implementation of Neutrosophic Logic: whenever there are two opposite sides, there is always a choice to find a neutral side, in order to reconcile those two opposite sides. We can also think of them starting from the *principle of contradiction*, proposed by Kolmogorov.[9] To summarize, he argues that there is fundamental problem in developing complex arguments, they always lead to contradiction. This was proven later by Gödel.

What can we conclude from Kolmogorov's principle of contradiction?

It is quite simple, i.e. developing a complicated theory from a number of postulates will very likely lead to messy contradictions, which are often called "paradoxes, " just like the twin paradox in general relativity, or cat paradox in quantum wave function.

To put this problem succinctly, we can paraphrase Arthur C. Clarke's famous saying: "Any sufficiently advanced technology is indistinguishable from magic," (Arthur C. Clarke, "Profiles of The Future", 1961[2]) to become "*Any sufficiently complicated theory will result in a number of contradictions and paradoxes.*"

Such a logical analysis derived from Kolmogorov's principle of contradiction eventually remind us of the following:

(a) To keep humble mind before Nature (God's creation), and perhaps we should not rely too much on our logic system and mathematical prowess;

(b) In developing a theory one should keep complications and abstractions to a minimum;

(c) To build theory in the nearest correspondence to the facts; it is the best if each parameter can be mapped to a measurable quantity.

We hope the above three criteria can be a useful set of practical guidelines for building mathematical models in theoretical physics.

To emphasize the aforementioned argument, from Neutrosophic Logic perspective, the old tensions between mathematicians (opposite 1) and experimenters (opposite 2), can be reconciled if we can consider a third approach. Those the available approaches would be somewhere in the following spectrum:

Mathematics (opposite 1) – evidence-based mathematics -- experiments (opposite 2)

[2] Clarke's third law. url: http://www.quotationspage.com/quote/776.html

Therefore, the middle way that we submit as a plausible resolution to the present stagnation of modern physics, is to return to evidence-based mathematics.

At this point, some readers may ask: "But how can we apply such principle of parsimony into practice?"

To put the above three criteria into more practical guidelines, allow us to distinguish such a Principle of Parsimony (Ockham razor) into several possible approach:

1. To minimize assumptions involved (conceptual simplicity)
2. To minimize number of parameters (model simplicity)
3. To minimize calculation procedures (calculational simplicity)
4. To minimize computational/algorithm entropy (computational simplicity)
5. To maximize coverage of empirical facts to be explained (evidence based physics)

To make these criteria a bit more comprehensible, we can draw a diagram as follows:

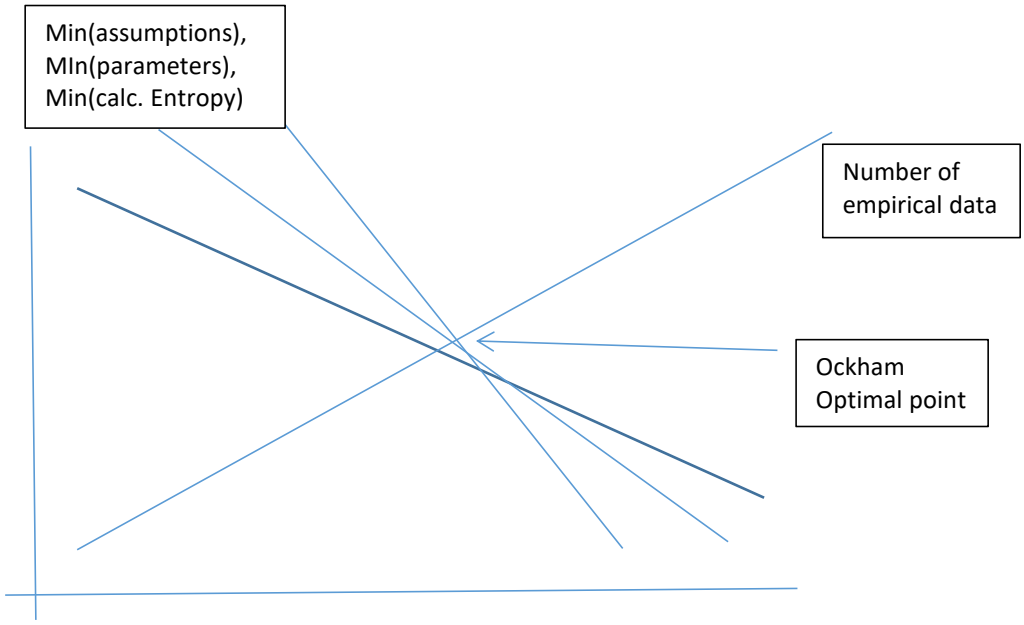

Diagram 2. To find Ockham optimality

Three examples

We have presented a more operational definition of Principle of Parsimony, allow us to give a few examples as illustrations, that sometimes: even the standard spacetime notion may be excluded to arrive at a good explanation of a set of observed phenomena.

A. Example 1 [14]

There are various models of electron which have been suggested, for instance see Chekh et al.

But we seek a more realistic electron model which is able to describe to experiments conducted by Winston Bostick et al. [17]. In our attempt to explain such experiments of electron creation in plasma, allow us to come up with a new model of electron, based on Helmholtz's electron vortex

theory. In turn, we will discuss a plausible model of electron capture event inside Earth (matter creation), which can serve a basis to explain Le Sage/Laplace's push gravity. We will discuss its implications along with receding Moon effect in a forthcoming paper.

The Helmholtz vortex model of the electron as illustrated in the photo of a Helmholtz vortex (Fig. 1), is a toroid made of nested concentric toroidal flows of smaller particles, perhaps the inertons of Krasnoholovets, or aggregate particles made from Bhutatmas. (The "Bhutatma" infinitesimal particle of Vedic lore is the ultimate building block of everything, being the smallest unit of matter, and at the same time, the smallest unit of Consciousness.

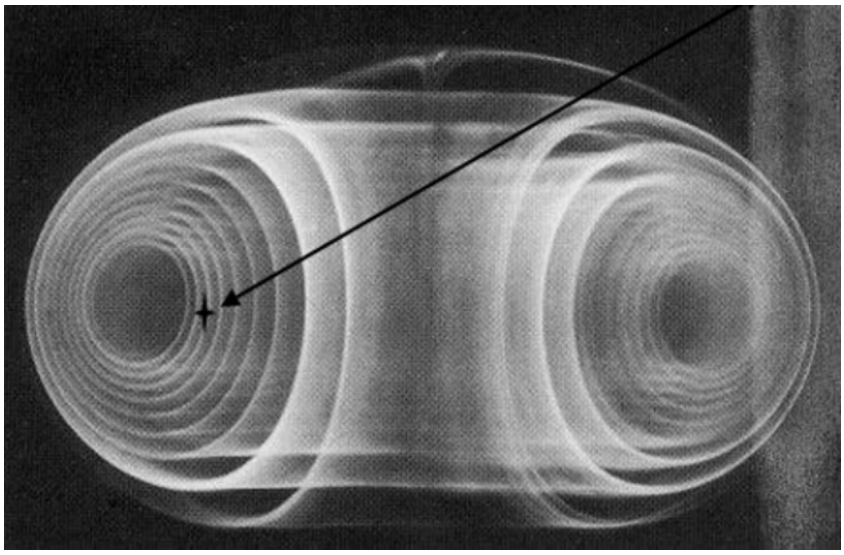

Figure 1. Helmholtz vortex model of electron (as verified by Bostick et al.)

B. Example 2 [15]

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 anisotropy 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.

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:

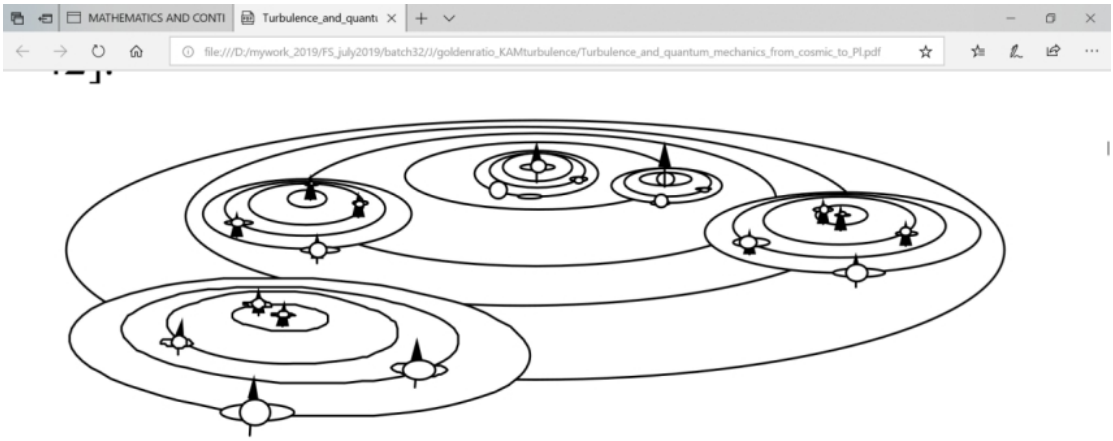

Fig.2 Description of internal (iso-spin) versus external vorticity fields in cosmology [41].

Figure 2. Vorticity fields in cosmology (after Siavash Sohrab [18])

The above diagram seems to be able to capture the turbulence phenomena from Planckian scale to cosmos.

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.

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 :

$$\nabla^{\alpha}\cdot u = div^{\alpha}u = \frac{\partial^{\alpha}u_1}{\partial x_1^{\alpha}} + \frac{\partial^{\alpha}u_2}{\partial x_2^{\alpha}} + \frac{\partial^{\alpha}u_3}{\partial x_3^{\alpha}}, \tag{1}$$

$$\nabla^{\alpha}\times u = curl^{\alpha}u = \left(\frac{\partial^{\alpha}u_3}{\partial x_2^{\alpha}} - \frac{\partial^{\alpha}u_2}{\partial x_3^{\alpha}}\right)e_1^{\alpha} + \left(\frac{\partial^{\alpha}u_1}{\partial x_3^{\alpha}} - \frac{\partial^{\alpha}u_3}{\partial x_1^{\alpha}}\right)e_2^{\alpha} + \left(\frac{\partial^{\alpha}u_2}{\partial x_1^{\alpha}} - \frac{\partial^{\alpha}u_1}{\partial x_2^{\alpha}}\right)e_3^{\alpha} \tag{2}$$

2. In Cantor-type cylindrical coordinates:

$$\nabla^{\alpha}\cdot r = \frac{\partial^{\alpha}r_R}{\partial R^{\alpha}} + \frac{1}{R^{\alpha}}\frac{\partial^{\alpha}r_{\theta}}{\partial\theta^{\alpha}} + \frac{r_R}{R^{\alpha}} + \frac{\partial^{\alpha}r_z}{\partial z^{\alpha}}, \tag{3}$$

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

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

$$\rho\frac{D^{\alpha}\upsilon}{Dt^{\alpha}} = -\nabla^{\alpha}\cdot(pI) + \nabla^{\alpha}\left[2\mu\left(\nabla^{\alpha}\cdot\upsilon + \upsilon\cdot\nabla^{\alpha}\right) - \frac{2}{3}\mu\left(\nabla^{\alpha}\cdot\upsilon\right)I\right] + \rho b \tag{5}$$

The next task is how to find observational cosmology and astrophysical implications.

C. Example 3 [16]

The ideas of detecting CνB have been discussed since the 1960s. However the direct observations of the relic neutrinos is a great challenge to present experimental techniques due to the very low energy (~10−4 eV) of relic neutrinos at the present epoch.

It is therefore natural to ask: what are the prospects of a more direct, weak interaction based relic neutrino detection, sensitive in particular to the CνB in the present epoch. It is known, that all the existing measurements probe

only the presence of the relic neutrinos at early stages in the cosmological evolution, and this often in a rather indirect way.

It is obvious that either WIMP or hot model of dark matter has not been observed yet. One of the most promising laboratory search, based on neutrino capture on beta decaying nuclei, may be done in future experiments designed to measure the neutrino mass through decay kinematics.

Another method is still underway, i.e. using PTolemy. According to Cocco:

"The PTolemy project aim at the direct detection of the Cosmological Relic Neutrino background by the use of a Tritium target. Cosmological Relic Neutrino produced in the early stage of the Big Bang are predicted to have thermally decoupled from other forms of matter at approximately 1 second after the Big Bang; they represent the oldest detectable Big Bang relics and as such they carry an invaluable content of information about the genesis and evolution of our Universe. …In particular Tritium is among the nuclei having the most favorable detection conditions." [19]

Despite all of those progress in developing measures to directly detect relic neutrino background, there is one possibility why such a direct detection remains elusive: because there was no such thing as cosmic

singularity. In other words, while we accept such an initial point of creation of the Universe, its beginning came through from a non-singular origin.

In two recent papers, we have outlined how a non-singular origin of the Universe is possible, if we consider a turbulence model of Early Universe, because the model includes nonlinear Ermakov equation instead of Friedman equation as usual.

Taking into considerations two other findings in recent years: (a) Earth Microwave Background by P-M. Robitaille, and (b) theories which suggest that cosmic singularity can be removed; then we submit the following hypothesis: Direct detection of Cosmic Neutrino Background is impossible because there is no such thing as Cosmic Singularity.

Concluding remarks

Despite majority of theoretical physicists begin to accept the *post-empiricism doctrine,* still few physicists and mathematicians alike don't agree with such a doctrine, partly because it is against Popper's criterion of *falsifiability* for any theory in physics and other sciences as well. And partly because criteria like beauty or elegance seem rather subjective for a theory to be accepted as "physics'.

In this article we have discussed several more operational criteria to apply the Principle of Parsimony into day to day model building processes. We also discuss *Ockham optimality* and also a number of examples.

Acknowledgment

Both authors wish to extend sincere gratitude to Robert Neil Boyd, PhD, for discussions and insights, especially with regards to examples (1-3) provided here. Special thanks to Dennis P. Allen, Jr., for reference to Polya, Hadamard and also his on-going works on Neo-Newtonian Mechanics and Gutschian Mechanics.

.

Version 1.0: 29th April 2021, pk. 21:00

Version 1.1: 09th June 2021, pk. 17:31

VC, FS

Further reading:

[1] George Ellis & Joe Silk. Defend the integrity of physics. *Nature* vol. 516, 18 December 2014.

[2] V. Christianto , F. Smarandache. Victor Christianto and Florentin Smarandache. "Exploring the Historical Debates on Irrational Numbers Using Neutrosophic Logic as a Balance between Intuition and Rational". *EC Neurology* 13.6 (2021).

[3] V. Christianto, R.N. Boyd, F. Smarandache. How to balance the intuitive and analytical function of the human brain. *E.C. Neurology* 11.7 (2019): 495-499.

[4] Iain McGilchrist. *The Master and his emissary: The divided brain and the making of the Western World.* Yale University Press, 2009.

[5] V. Christianto & F. Smarandache. "Lost in Math": The perils of postempirical science and their resolution. *Prespacetime J.* 2020

[6] V Christianto & F Smarandache. A Review of Seven Applications of Neutrosophic Logic: In Cultural Psychology, Economics Theorizing, Conflict Resolution, Philosophy of Science, etc. *J,* March 2019. www.mdpi.com

[7] George Ellis. The Multiverse, ultimate causation, and God. Talk at Emmanuel College, 6th Nov. 2007. url: https://www.faraday.st-edmunds.cam.ac.uk/resources/George%20Ellis%20Lecture/Ellis-Faraday.pdf

[8] Jim Baggott. Post-empirical science is oxymoron. *Aeon.* url: https://aeon.co/essays/post-empirical-science-is-an-oxymoron-and-it-is-dangerous

[9] Charpentier, E.; Nikolski, A.L.N. *Kolmogorov heritage in mathematics.* Springer: Berlin/Heidelberg, Germany, 2007, p. 25

[10] Peter Woit. *Not even wrong.* London: Jonathan Cape, 2006.

[11] Sabine Hossenfelder. *Lost in Math: How beauty leads physics astray*. Basic Books, 2018. url: https://www.amazon.com/Lost-Math-Beauty-Physics-Astray/dp/0465094252

[12] Richard Dawid. *String theory and the scientific method*. Cambridge: Cambridge University Press, 2013.

[13] R. Dadashti, R. Dawid, K. Thebault. *Why trust a theory? Epistemology of fundamental physics*. Cambridge: Cambridge University Press, 2019.

[14] V. Christianto, F. Smarandache & R.N. Boyd. Towards Helmholtz's electron vortex from Kolmogorov's theory of turbulence and a new model of origination of charge and matter. *Prespacetime J.*,. 2019.

[15] V. Christianto. F. Smarandache, Y. Umniyati. Towards Gross-Pitaevskiian description of Solar System and Galaxies and more evidence of chiral superfluid vortices. *Prespacetime J.*, 2020.

[16] V. Christianto & F. Smarandache. Direct Detection of Relic Neutrino Background remains impossible: A review of more recent arguments. *Prespacetime J.,* 2019.

[17] Winston H. Bostick. What Laboratory-Produced Plasma Structures Can Contribute to the Understanding of Cosmic Structures Both Large and Small. IEEE *TRANSACTIONS ON PLASMA SCIENCE,* VOL. PS-14, NO. 6, DECEMBER 1986; [17a] W.H. Bostick. The Morphology of the Electron. *International Journal of Fusion Energy,* Vol. 3, no. 1, 1985

[18] Siavash H. Sohrab. *Turbulence and quantum mechanics from cosmos to Planck Scale*. url: http://www.mech.northwestern.edu/web/people/faculty/sohrab.php

[19] Alfredo G. Cocco. PTolemy - Towards Cosmological Relic Neutrino detection. *Neutrino Oscillation Workshop* 4 - 11 September, 2016 - Otranto (Lecce, Italy)

[20] G. Polya. *How to solve it: A new aspect of mathematical method*. Second edition. Princeton: Princeton University Press, 1957, pp. vii.

[21] Jacques Hadamard. *An essay on the psychology of invention in the mathematical field*. New York: Dover Publications, Inc., 1945.

[22] Dennis P. Allen, Jr.. & J. Dunning-Davies. *Neo-Newtonian Mechanics*. 14th edition. Available at ResearchGate (2019). ISBN:1491024895

[23] Dennis P. Allen, Jr. *Foundations of Gutschian Mechanics*. Part I: Basics. Available at ResearchGate.