

Perspective

Beyond Post-Empiricism Doctrine: A New Philosophy of Discovery

Victor Christianto^{*1,2}, Florentin Smarandache³ & Yunita Umniyati⁴

¹Ekklesia Advanced School of Theology (EAST), Jakarta, Indonesia

²Halton Arp Institute, affiliated to International Mariinskaya Academy, St. Petersburg

³Dept. Math. & Sci., Univ. of New Mexico, Gallup, United States

⁴Dept. Mechatronics, Swiss-German University, Tangerang, Indonesia

Abstract

Despite majority of theoretical physicists begin to accept the *post-empiricism doctrine*, still few physicists and mathematicians alike do not 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 *new theory* to be accepted as “physics”. Some physicists have written books on this topics [10-11]. In this article, we will not repeat those arguments; instead we only argue in favor of *principle of parsimony* that Nature seems to prefer least action, or least energy either in modeling complexity, assumptions and free parameters involved; thus, it is likely that minimizing computational entropy is 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*.”

Keywords: Principle of parsimony, Popperian epistemology, post-empiricism doctrine, Ockham optimality point, theoretical physics, mathematical physics.

I consider it quite possible that physics cannot be based on the field concept, i.e., on continuous structures. In that case nothing remains of my entire castle in the air gravitation theory included, and of the rest of modern physics. - Albert Einstein

1. 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, M-theories and also supersymmetry 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.

*Correspondence: Victor Christianto, Ekklesia Advanced School of Theology (EAST), Jakarta, Indonesia.
Email: victorchristianto@gmail.com

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 [7][8]. 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 at research practice on daily basis. Therefore, there is a need to apply such criteria on simplicity or *principle of parsimony* in a more operational way.

2. Intuition and Neutrosophic way of doing science

In a recent article, we argue on the role of intuition in doing science [2][3], 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, *einfihlung*) 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 actual experiences 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 experientable 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.

Therefore, to reply to the question concerning rectifying the problem of overemphasizing *rationality in mathematics*, McGilchrist's concept and Conceptual Linguistics theory can shed light [2, 4].

From Neutrosophic Logic viewpoint, this article recommends that a combination:

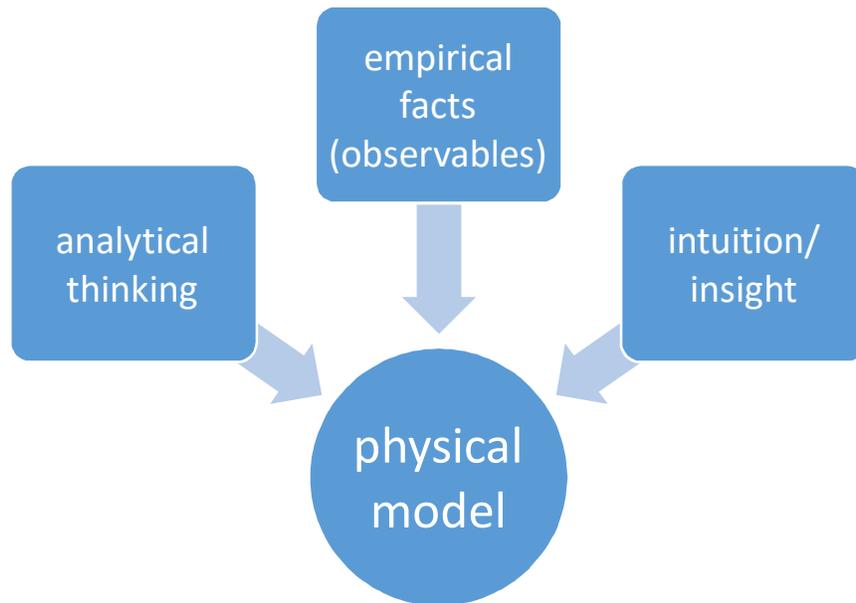


Diagram 1. The role of intuition, analytical thinking, and empirical facts

In the above diagram, we emphasize both the intuitive aspect of the right hemisphere and the analytical or logical thinking processes of the human's left brain, that they 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, see Diagram 1 above.

To illustrate the aforementioned point, and regarding our personal experience, the first author shares a little about his dream long time ago of being an inventor. In the past, he was educated at one of the engineering faculties at a state campus in East Java, Indonesia. But about halfway through his engineering study, he found passion in more humanities books: such as, E.F. Schumacher etc. And also how to think more creatively. When he read textbooks such as

foundation engineering, such as *la terre armee* (earth reinforcement), what comes to mind is not just how to calculate and so on. But it was more about the process of making the discovery: How did Henri Vidal find *la terre armee*?¹ - then how did people find the prestressing method? Or how Dr. Sedijatmo found the chicken-raft foundation? (cf. It is one of Indonesia's engineering invention)².

Only recently, around two years ago, after discussions with several senior physicists, notably RNB, there was a suggestion that the discovery process generally begins through intuition, or to be precise the right brain thinking process. Although there is also an analytical process, it is usually an analytical process will not yield any significant new findings. From there then began to develop the term: "*intuilytics*." For physicists, some readers are more familiar with the German phrase: "*enfuhlung*."

Then he found the work of a psychiatrist: Iain McGilchrist which actually reinforces this belief, meaning that the centuries-old tendency to put pressure on the left brain function is not good and *tends to destruct the entire Western civilization* [4]; and if humanity wants to grow its consciousness, it must prioritize right brain functions first, including the functions of holistic, spiritual, and intuitive thinking.³ New analytic function is only to verify what the right-brain process registers. That's why he doesn't agree with the idea of transhumanism, ala *Homo Deus*, as suggested by Yuval Noval Harari, a historian from Hebrew University. It is more likely, the future of humanity is heading toward "*homo spiritus*," in Sir David R. Hawkins' term [24]. He does not see a good future if we continue the process of integrating humans and data, then as a whole we will be tapped and consumed by big data and supercomputers. And this is precisely what the IoB/Rand Report's plan seems to be designed for (IoB: internet of bodies). Praise God, our article on the relationship of integrative thinking/McGilchrist and reinterpreting Pancasila, our nation's philosophy of life, has been published recently in the NPTRS Journal [25].

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

¹ Url: <https://www.terre-armee.com/about/>

² Origin of discovery: "The chicken claw foundation was discovered by Professor Sedijatmo in 1961. At that time, Sedijatmo accidentally saw a palm tree trunk swaying in the wind. The palm tree remained firmly standing even though the soil structure was unstable. From here, Sedijatmo created a "stringy" foundation of concrete pipes that support large buildings, known as the chicken claw foundation. This chicken claw foundation adopts the shape of the palm tree adaptation ..." source: <https://brainly.co.id/tugas/26826541>

³ *Postscript note*: Interestingly, John Perkins, a best-seller author of popular economics books, also argues in favor of Life Economy, in contrast to common practice of Death Economy. Life Economy can be argued as more appreciative to human and Nature's life, much more than short term utility maximisation. The difference here is that in Perkins's thought, Death Economy began around 1970-1980s, while according to Dr. Iain McGilchrist, it went back to at least 16 centuries back to early Church Fathers. Nonetheless, in his book, Perkins argue a set of practical ways to do more towards realization of Life Economy. See: John Perkins, *Touching the Jaguar*. Oakland: Berrett-Koehler Publishers, Inc., 2020.

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 field⁴.

So what would such a discussion bring to us? May be if we rely and follow through 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* by a senior mathematician fellow, Dennis P. Allen, Jr., *et al.* [22-23].

3. On Principle of Parsimony & 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: i.e. 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. See [6].

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*”, 1961⁵) to become “*Any sufficiently complicated theory will result in a number of contradictions and paradoxes.*”[6]

Such a logical analysis derived from Kolmogorov’s principle of contradiction eventually remind us of the following:[6]

- (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; &

⁴ Special thanks to Dennis P. Allen, Jr., for reference to G. Polya, J. Hadamard and also his on-going works on Neo-Newtonian Mechanics and Gutschian Mechanics.

⁵ Clarke's third law. url: <http://www.quotationspage.com/quote/776.html>

- (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, cosmology etc.

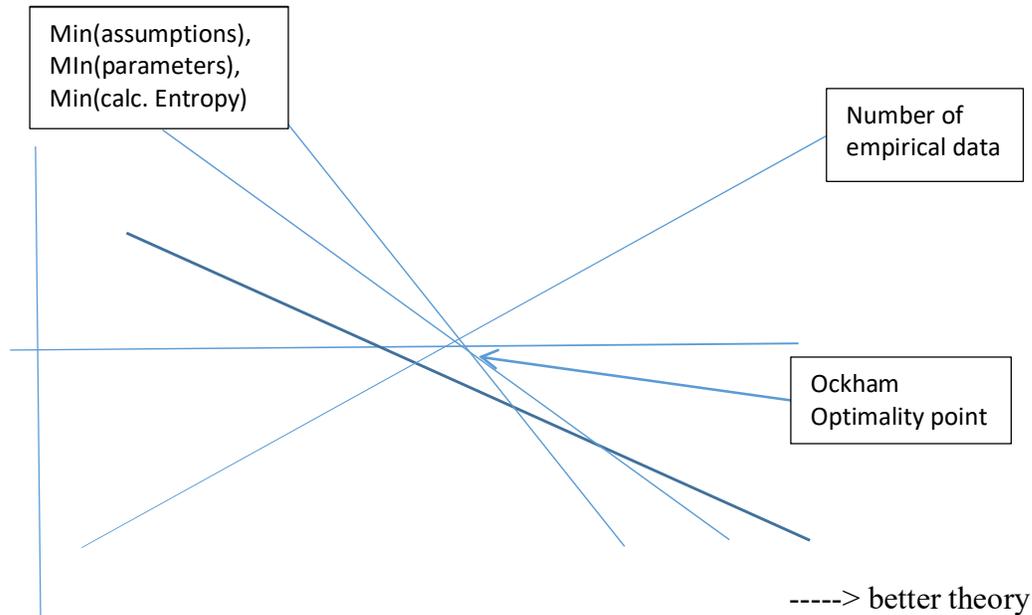


Diagram 2. How to find Ockham optimality point

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)

Therefore, the middle way that we submit as a plausible resolution to the present stagnation of modern physics, is to come up with “*evidence-based mathematics.*” At this point, some readers may ask: But how can we apply such a principle of parsimony into practice?

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

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:

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.

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 discussed its implications along with receding planets effect from central Sun in a paper.⁶

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.)

⁶ Postscript note: see Christianto, Boyd, Smarandache, 5th Conference of Plasma Physics, held in Stockholm, 2018.

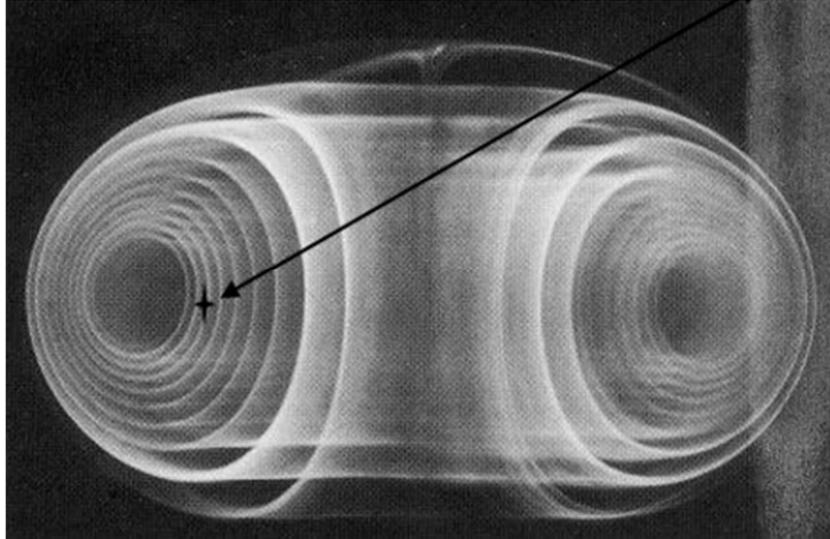


Figure 1. Helmholtz vortex model of electron (as verified by Bostick *et al.* [17])

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 (cf. R.N. Boyd). 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:

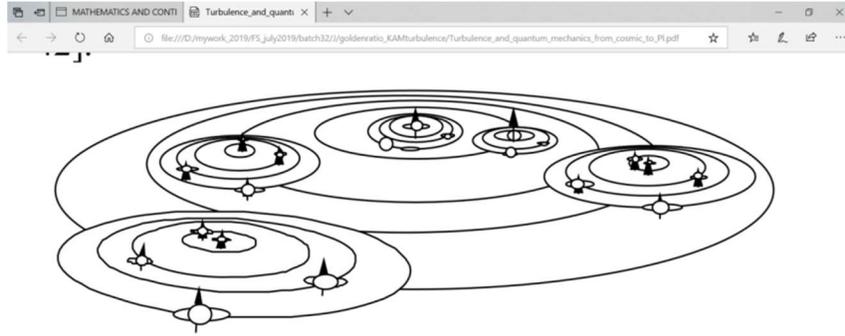


Fig.2 Description of internal (iso-spin) versus external vorticity fields in cosmology [41].

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.

Now one of questions is: 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:

In Cantor coordinates :

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

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

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 :

$$\rho \frac{D^\alpha v}{Dt^\alpha} = -\nabla^\alpha \cdot (pI) + \nabla^\alpha \left[2\mu(\nabla^\alpha \cdot v + v \cdot \nabla^\alpha) - \frac{2}{3}\mu(\nabla^\alpha \cdot v)I \right] + \rho b \quad (4)$$

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

Example 3:

Many physicists and philosophers alike have debated a long standing puzzle: whether the space is continuous or discrete. It has been known for long time that most of the existing cosmology models rely on pseudo-Riemannian metric as the cornerstone of Einsteinian universe. But the metric itself is based on continuum model. It is known that such models have led us to too many (monster) problems, including dark matter and dark energy etc. Now what if the universe is discrete? Then perhaps we can solve these problems naturally.

Philosophically speaking, the notion of discrete space can be regarded as basic question in definition of differential calculus and limit. If it is supposed that space is continuous then we can use standard differential calculus, but if we assume it is finite and discrete, then we should use difference equation or finite difference theories. This problem is particularly acute when we want to compute our mathematical models in computers, because all computers are based on discrete mathematics. Then we can ask: is it possible that the discrete mathematics can inspire cosmology theorizing too?

Despite majority of cosmologists rely on such a Standard Model which is called Lambda CDM theory, we will explore here the redshift theory based on a few of lattice-cellular models, including Lindquist-Wheeler theory and beyond it.

We will discuss here some peculiar models such as Voronoi tessellattice and also Conrad Ranzan's cellular model. It is our hope that the new proposed method can be verified with observation data.:

a. Lindquist-Wheeler's theory:

In this model, the matter content is assumed to be discrete; identical spherically symmetric islands uniformly distributed in a regular lattice. This attempt was first introduced in 1957 by Lindquist and Wheeler (LW) in a seminal paper. While LW suggested that their global dynamics is similar to Friedmann universe for closed dust dominated universe, Shalaby has shown that LW-model can be extended to yield a redshift equation, as follows [16-16a]:

$$1 + z = 1 + \langle \gamma \rangle \ln \left(\frac{a_r}{a_e} \right) = 1 + \langle \gamma \rangle \ln(1 + z_{FRW}) \cong (1 + z_{FRW})^{\langle \gamma \rangle} \quad (5)$$

It can be shown, that the value of $\langle \gamma \rangle$ approximates geometrically to be $2/3$, however, numerically its value was estimated to be $7/10$. Liu also analyzed LW model, and he concludes that the LW redshifts can differ from their FLRW counterparts by as much as 30%, even though they increase linearly with FLRW redshifts, and they exhibit a non-zero integrated Sachs-Wolfe effect, something which would not be possible in matter-dominated FLRW universes without cosmological constant [16a].

b. Voronoi Tessellation model:

Rien van de Weygaert describes a novel model based on Voronoi tessellation. The spatial cosmic matter distribution on scales of a few up to more than a hundred Megaparsec displays a salient and pervasive foamlke pattern. Voronoi tessellations are a versatile and flexible mathematical model for such weblike spatial patterns. Cellular patterns may be the source of an intrinsic geometrically biased clustering. However, so far we do not find a redshift equation from this model [26].

c. Nonexpanding cellular universe:

Conrad Ranzan suggests a DSSU cellular cosmology (dynamics steady state universe), which he claims to be problem-free. The cosmic redshift is shown to be a velocity-differential effect caused by a flow differential of the space medium. He obtains the cosmic redshift equation in its basic form[27]:

$$z = (1 + z_{GC})^N - 1 \quad (6)$$

There are of course other cellular cosmology models, some of them have been reviewed by Marmet, but this paper is not intended for such an exhaustive list of redshift models.⁷

4. On Self-Organized Criticality as a Model of the Scientific Development

In the aforementioned sections, we argue in favour of more balanced-brain approach to scientific discovery process, which we submit with a new term “intuilytics”. In this section, allow us to put forth an alternative perspective other than “revolutionary” model of scientific development (cf. Thomas Kuhn.) If we are willing to learn from history, “*revolution*” word often leads to fascism. And in that case, there is wise phrase to warn us: “You can build a throne out of bayonets, but you can't sit on them long.”⁸

⁷ *Postscript note:* Elsewhere, in a paper at Prespacetime Journal, we discussed Zeldovich's approach which is often called as “cosmic web” theory, which seems to capable to discrete cellular large-scale pattern of the Universe. Interestingly, several researchers argue in favor to linking the cosmic web theory with galactic grids, and even some authors argue that advanced interstellar travelling methods can be devised through those galactic grids; also known as *cosmic filaments*.

⁸ <http://marvin.cs.uidaho.edu/About/quotes.html>

In our proposed perspective, in its simplest form and according to a conventional belief held by most science communities, sciences can advance by at least four ways: (a) Incremental approach by virtue of scientific methods; (b) Paradigm shift; (c) Christensen's disruptive change; (d) Self-organized criticality, but they are rarely employed for describing scientific progress.

Paradigm shift has been advocated by a notorious science historian, Thomas Kuhn. According to his proponents, one of the most interesting features of Thomas Kuhn's work in "*The Structure of Scientific Revolutions*" is its naturalism. But naturalism is just another philosophical strand which may or may not agree with empirical data itself. Despite its widespread acceptance, the fact is that such a term of paradigm shift is not often tested empirically. There are other ways to describe innovation changes, namely, alternative (c) and (d) above.

Therefore, we will review a recent work which uses citation analysis of journal-journal for the past recent years. This analysis reveals that scientific progress seems to follow self-organized criticality.

A review of 4 methods of human knowledge progress

There are some papers in literature which indicate those 4 methods, as we will review briefly as follows:

- a. Incremental approach: by virtue of scientific methods, science advances by small steps. Until the 1950s, the hegemony of logical empiricism reached to its highest level- by the representatives of the logistic approach such as R. B. Braithwaite, Rudolf Carnap, Herbert Feigl, Carl G. Hempel, and Hans Reichenbach. Prior to Kuhn's SSR, historians and philosophers of science considered the scientific enterprise to be a rational endeavor in which progress and knowledge are achieved through the steady, daily, rigorous accumulation of experimental data accredited facts and new discoveries [30][31].
- b. Paradigm shift:
Thomas Kuhn's Structure of Scientific Revolutions (SSR) is accepted to be one of the main books in the twentieth century. The book considered an entire industry of editorial, translation, and interpretation. The development of another scholarly discipline - the social science of science-appeared around a common worldview following Kuhn's accentuation on the significance of networks of researchers. After the book was distributed analysts started to look at logical teaches much as sociologists concentrated on friendly/social gatherings, and in which science was viewed not as the most regarded, unapproachable result of the Enlightenment yet as simply one more subculture. However, as Kuhn guaranteed "*the way of thinking and humanism of science can't be drilled freely of one another.*" However, Kuhn saw the networks (not people) as the essential

specialists of science and he imagined that networks should be described by the particular mental qualities to which they are committed.

After the 1960s and 70s, following Kuhn's historiography, and savants, for example, Paul Feyerabend, Imre Lakatos, Larry Laudan and Michael Polanyi have enormously added to the making of an enemy of positivistic way of thinking of science as another custom. History of science after Kuhn has every now and again taken an all the more intentionally externalist line, in looking external science for the reasons for the substance of science [30][31].

c. Disruptive change:

In his article in *Harvard Business Review*, Clayton Christensen, differentiates between: Sustaining innovations and disruptive innovations.[33] This seems to follow Schumpeterian view of creative destruction. But this paper will not focus on disruptive innovation. See also his more recent article in HBR 2015.

d. Self-Organized Criticality:

Self-organized criticality is a rich phenomenon as it combines self-organization and criticality to describe complexity. This concept was first introduced by P. Bak and the collaborators in the seminal paper in 1987, and also in his book [32]. This notion is meant to be a property of dynamical systems to organize its microscopic behavior to be spatial (and/or temporal) scale independent. That resembles of the critical behavior of the critical point of phase transitions.

Now, allow us to discuss shortly a comparison between citation analysis of journal-journal as a way of knowledge creation process, and our computational simulation approach of creation process of the Universe, based on Ermakov nonlinear equation, as follows:

Results of citation analysis

Bolijka Tadic *et al.* have reported self-organized criticality pattern in online social behavior especially in knowledge creation process [30]. But the first convincing citation analysis to prove this pattern has been made by Loet Leydesdorff, Caroline S. Wagner, and Lutz Bornman [20]. As we know, journals play a crucial and institutionalized role in the validation of knowledge claims and in the incorporation of new knowledge into the archive of science. Given their role in the codification of knowledge, journals can be considered as an organizing layer of the scientific literature. Not incidentally, the *Science Citation Index* (SCI) and its derivatives (the *Social Sciences Citation Index* (SSCI) and the *Arts & Humanities Citation Index* (AHCI)) were defined in terms of specific journal selections (Garfield, 1972; 1979b), as is Scopus, the main competitor of the SCI since 2004 [29][30].

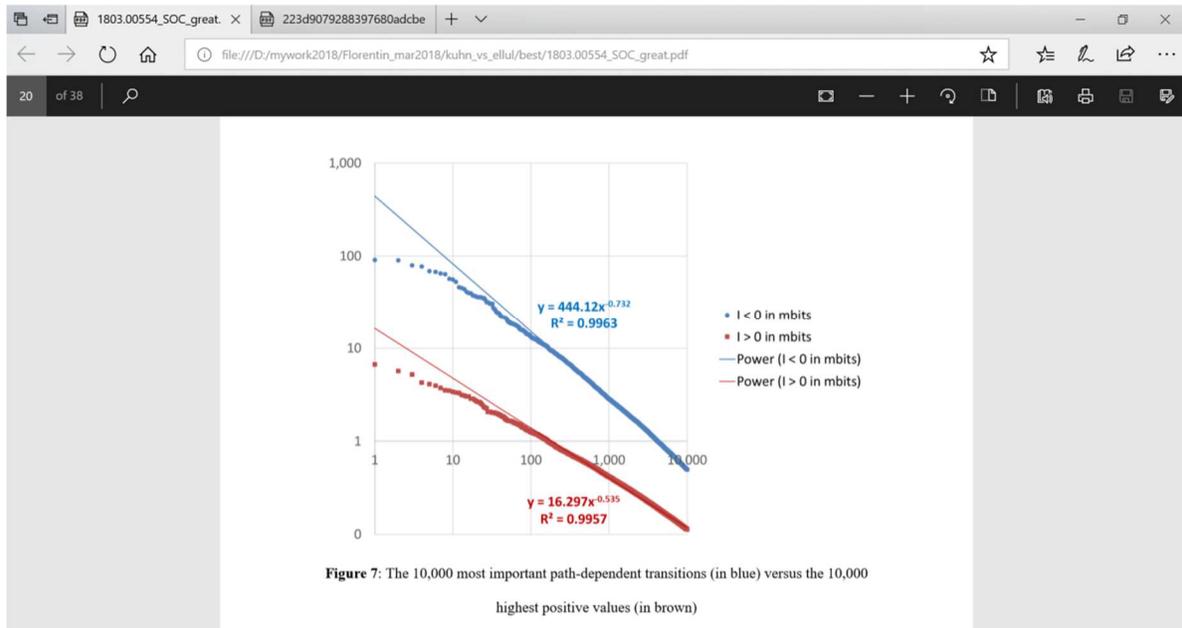


Diagram 3: Source: Leydesdorff *et al.* [29]

Comparison with our model of abrupt origin of the Universe

Now we will compare this citation analysis result with our proposed model of the origin of the Universe. 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.

In other paper, we obtained an Ermakov-type equation following Nurgaliev [35]. Then we solve it numerically using Mathematica 11. An interesting result from that simple computational simulation is shown in the following diagram [36][37]:

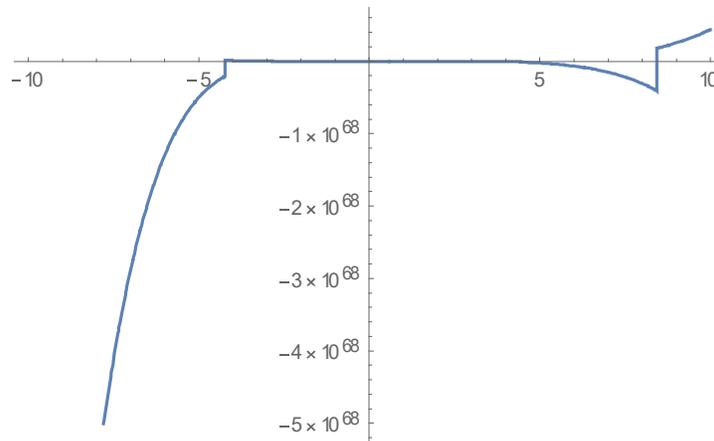


Diagram 4. Plot of Ermakov-type solution for A=1, B=-10 (after [36-37])

From the above computational simulation, 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 Diagram 4, 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 observed “accelerated expansion.” Comparing our model of abrupt origin of the Universe with the above citation analysis, it seems both reveal similarities. But whether such an abrupt creation/origin of the Universe also indicates Per Bak’s model feature, remains open for further study.

5. Conclusions

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. Further, despite its enormous popularity in the past 5-6 decades, paradigm shift view of scientific progress has not been tested quite often. Therefore, in this paper we review a recent work which uses citation analysis of journal-journal for the past recent years. This analysis reveals that scientific progress seems to follow *Self-Organized Criticality pattern*. Comparing our model of abrupt origin of the Universe with the above citation analysis, it seems both reveal similarities. But whether such abrupt origin of the Universe also indicates SOC feature, remains open for further study.

It can be expected that the above discussions will shed some lights on such an old problem especially in the context of modelling scientific progress based on empirical data (evidence based). This is reserved for further investigations.

Postscript

In a recent draft paper with S. Ershkov, S. Alhowaity & E.I. Abouelmagd,⁹ we argue that there is analytical solution of Ermakov-Pinney equation, which is usually considered difficult to solve analytically. By mentioning previous works by Tsekov (Physica Scripta, etc.), and also Lidsey on BEC cosmology, even if we don’t have a complete arguments yet at hand, we are convinced that if there is a

⁹ Sergey Ershkov, Victor Christianto, Sawsan Alhowaity, & Elbaz I. Abouelmagd. *Revisiting solving procedure for Ermakov–Pinney equation with applications in the field of cosmology*. In preparation, to be submitted to a physics journal, May 2022.

(nonlinear dynamics) equation which can describe both microcosm realm (QM) as well as macrocosm dynamics (cosmology), that is Ermakov-Pinney equations. More interestingly, EP equations can be transformed into Riccati equations. Maybe, just maybe, this is a little step toward finding a *low-temperature physics approach of everything* (LTPE), as we already know from discussion above that superstring/M theory and its multiverse implications is hopeless (cf. P. Woit, also S. Hossenfelder, [10-11]). Nonetheless, we admit that there is still long road to go on this approach of low temperature cosmology.

Acknowledgment:

Both authors wish to extend sincere gratitude to Robert N. Boyd for discussions and insights, especially with regards to examples (1 & 2) provided here. Special thanks to Dennis P. Allen, Jr., for reference to G. Polya, Hadamard and also his on-going works on Neo-Newtonian Mechanics. Special thanks to Prof. Thee Houw Liong for bringing up future science and technology in a recent RG forum.

References

- [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-Pitaevskiiian description of Solar System and Galaxies and more evidence of chiral superfluid vortices. *Prespacetime J.*, 2020.
- [16] Mohamad Shalaby. Dynamics and Light Propagation in a Universe with Discrete-Matter Content. arXiv: 1205.68773 [gr-qc]; also [16a] Rex G. Liu. The Lindquist-Wheeler formulation of lattice universes. arXiv: 1501.05169 [gr-qc]
- [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.
- [24] David R. Hawkins. *Homo Spiritus: Devotional Nonduality: Enlightenment*. USA: Veritas Publishing, Nov. 22nd, 2012. url: <https://www.goodreads.com/book/show/36327593-homo-spiritus>
- [25] Victor Christianto, Robby Igusti Chandra, Florentin Smarandache. A re-introduction of Pancasila from Neutrosophic Logic perspective: In search of the root cause of deep problems of modern societies. *Jurnal NPTRS, STT Cipanas*, Vol 2, No 2 (2021).
- [26] Rien van de Weygaert. Voronoi Tessellations and the Cosmic Web: spatial patterns and clustering across the Universe. *Proceedings of the Fourth International Symposium on Voronoi Diagrams in Science and Engineering (ISVD 2007)*, ed. C. Gold, IEEE Computer Society, July 2007.
- [27] Conrad Ranzan. Cosmic redshift in the nonexpanding cellular universe: velocity-differential theory of cosmic redshift. *American Journal of Astronomy and Astrophysics* 2014, 2(5): 47-60
- [28] _____. Large scale structure of the Dynamic Steady State Universe. *American Journal of Astronomy and Astrophysics* 2016, 4(6): 65-77.
- [29] Loet Leydesdorff, Caroline S. Wagner, and Lutz Bornman. Discontinuities in Citation Relations among Journals: Self-organized Criticality as a Model of Scientific Revolutions and Change. arXiv: 1803.00554 (2018)

- [30] Bosiljka Tadic, Marija Mitrovic Dankulov, and Roderick Melnik. The mechanisms of self-organised criticality in social processes of knowledge creation. arXiv: 1705.0982 (2017)
- [31] Turkan Firinci Orman. "Paradigm" as a Central Concept in Thomas Kuhn's Thought. *International Journal of Humanities and Social Science*, vol. 6, no. 10 (2016)
- [32] Per Bak. *How Nature Works*. New York: Springer, 1996.
- [33] Clayton M. Christensen & Michael Overdorf. Meeting the Challenge of Disruptive Change. *HBR On Point*, March-April 2000. www.hbr.org; [31a] Clayton M. Christensen *et al.* <https://hbr.org/2015/12/what-is-disruptive-innovation>
- [34] Vladyslav A. Golyk. Self-organized criticality. Url: <https://pdfs.semanticscholar.org/7084/223d9079288397680adcbe129c2ad323b45e.pdf>
- [35] Ildus S. Nurgaliev. E pur si muove! arXiv: 1210.4091. See also [35a] Ildus S. Nurgaliev. Singularities are averted by vortices. *13th Gravitational Conference – International Conference on Gravitation, Cosmology and Astrophysics*. June 23-28, 2008. People's Friendship University of Russia (PFUR), Moscow, Russia. Published by PFUR, ISBN 978-5-209-03274-8, pp. 117–118; [34b] Also in *Gravitation and Cosmology* vol. 16 no. 4 (2010) pp. 313-315.
- [36] Victor Christianto & Florentin Smarandache & Yunita Umniyati. Solving Numerically Ermakov-type Equation for Newtonian Cosmology Model with Vortex. *Prespacetime Journal*, Oct. 2017. www.prespacetime.com
- [37] Victor Christianto & Florentin Smarandache. How Neutrosophic Logic may Resolve Dispute on the Origin of the Universe through re-reading Gen. 1:1-2. *Asia Matematika J.* vol. 2, no. 2 (2019).