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On the Origin and the Existence of the World

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Abstract

We consider evolution of the Universe according to the standard Big Bang model, quantum models of creation (e.g. Hartle & Hawking 1983; Witten 1995; Steinhardt & Turok 2002), and recent theory of nonlinear dynamics, including deterministic chaos (Stewart 1990), fractals (Mandelbrot 1982), and multifractals (Macek 2012). We show that by looking for an order and harmony in the the complex surrounding real world these modern studies give also new insight into the most important philosophical issues exceeding the classical ontological principles, e.g., providing a deeper understanding of an old emotional philosophical question: why does something exist instead of nothing (Macek 2013)?

We believe that those modern concepts can bridge science and religion. Therefore, we can discuss the consequences of science and religion for the sense of human life in the surrounding Universe (Heller 1996, 2010). Admittedly, even though the methods of science and religion are different, studies on quantum reality (Espagnat 1983) suggest that one can mutually help each other to approach the unique Truth (Heller 2010). In fact, in mathematical-natural sciences we ought to look for the sense of the world in the mystery of rationality; the sense of its existence is the justification of the Universe. In our view this requires new philosophical concepts based on metaphysics exceeding the classical ontological principles (Macek 2000). Moreover, in our experience science is continuously renewing our thoughts about God (Macek 2009, 2010, 2011).

Finally, we believe that this scientific view gives also sense and hope to human existence. Therefore, it would seem that both science and religion provide important contributions that shape our emotions when we experience the world in which we are immersed.

1. INTRODUCTION

In the scientific literature evolution of the Universe is based on the Big Bang model, which has now become a standard scenario. However, very little is known about the early stages of this evolution, where we should rely on some models, because the required quantum gravity theory is still missing.

On the other hand, creation of the world is usually an important issue of religion (theology of creation). Nevertheless these two domain of human activity seemed to often be in conflict, some scientists and philosophers have noticed that the aim of science is to explore the Universe created by God; science and natural theology have different methods but they have the same subject (Heller 1996).

Obviously, to bridge science and religion a proper philosophy is required. Hence, one should return to great philosophers starting from the Greeks, who asked the questions about the origin of existence of the world, e.g.,

- Aristotle's universe according to whom the world always existed, but needed the **eternal** (atemporal) First Mover
- Plato's creation: a Demiurg transformed an initial **chaotic** stuff into the ordered **Cosmos**

- St. Augustine's Creator (in the fullest sens): a **Being** from whom the existence (in time) of all things derives (from 'nothingness 'in the past to 'nothingness' in the future).

In this paper, we would like to consider the origin of the Universe in view of the modern science, including quantum models of creation, recent theory of nonlinear dynamics, deterministic chaos and fractals. We hope that these studies give us also a new insight into the most important philosophical issues exceeding the classical ontological principles, e.g., providing a deeper understanding of an old philosophical question: *Why does something exist instead of nothing?* Gottfried Wilhelm von Leibniz (1646–1716).

Basically, in this paper we argue that a simple **nonlinear** law, within theory of chaos and (multi-)fractals, can possibly describe a hidden ORDER for the creation of the Universe. Let us also give the other citation, which will help us to understand the main issue of our presentation:

Chaos is the score on which reality is written. Henry Miller (1891-1980).

Finally, since we believe that mathematical natural sciences would admit a better understanding sense of man in his relation to the Universe let us cite Michael Heller (born 1936) according to whom i*n the environemnet of Sense the life is worth to live*.

2. EVOLUTION OF THE UNIVERSE

According to the Big Bang model, the Universe expanded from an extremely dense and hot state and continues to expand today. A common analogy explains that space itself is expanding, carrying galaxies with it, like spots on an inflating balloon. The graphic scheme here is an artist's concept illustrating the expansion of a portion of a flat universe (Fig. 1).

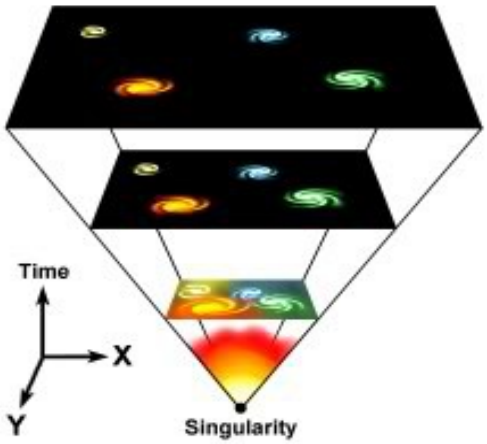

Fig. 1: Expanding Universe, from cfa.harvard.edu/seuforum/

Based on the best available measurements of Wilkinson Microwave Anisotropy Probe (WMAP) in 2010 the original state of the universe existed around 13.7 billion years ago, when the Big Bang occurred. This was possibly followed by an "inflation" produced a burst of exponential growth in the size of the universe. The first second consisting of electroweak, quark, and hadron epochs, together with lepton epoch (till 3 minutes of its existence) were decisive for further evolution, leading to nucleosynthesis of helium from hydrogen. Only after 70 thousands of years light was separated from matter. The afterglow light seen by WMAP was emitted about 400 thousands years after the beginning (when the electrons and nucleons are combined into atoms, mainly hydrogen) and has traversed the universe largely unimpeded since then. The conditions of earlier times are imprinted on this light; it also forms a backlight for later developments of the universe. First stars appears about 400 millions years later.

After formation of galaxies and finally the Solar System about 5 billions years ago, for the next several billion years, the expansion of the universe gradually slowed down as the matter in the universe pulled on itself via gravity. More recently, the expansion has begun to speed up again as the repulsive effects of **dark energy** have come to dominate the expansion of the universe.

2.1 Origin of the Universe

2.1.1 Where did the universe come from?

However, no one knows how the first space, time, and matter arose. And scientists are grappling with even deeper questions:

- If there was NOTHING to begin with, then where did the laws of nature come from?
- How did the universe "know" how to proceed?
- And why do the laws of nature produce a universe that is so hospitable to LIFE?

As difficult as these questions are, scientists are attempting to address them with bold new ideas — and new experiments to test those ideas.

2.1.2 In search of quantum gravity

Understanding how the universe began requires developing a better theory of how space, time, and matter are related. In physics, a theory is not a guess or a hypothesis. It is a mathematical model that lets us make predictions about how the world behaves. Einstein's theory of gravity, for example, accurately describes how matter responds to gravity in the large-scale world around us.

And our best theory of the tiny sub-atomic realm, called **quantum** theory, makes very accurate predictions about the behavior of matter at tiny scales of distance.

But these two theories are not complete and are not able to make accurate predictions about the very earliest moments when the universe was both extremely dense and extremely small.

2.2 Standard Model of Forces

According to the Standard Model we have three generations of elementary particles: quarks (up and down, charm and strange, top and bottom) and leptons (electron, muon, and tau particles with the corresponding neutrinos). The gauge bosons responsible for interactions (gluon and photons for quarks, with heavy bosons Z and W for leptons) are in the fourth generation and finally the Higgs boson is in the fifth, providing the mass to particles. We can have four basic types of interactions between particles: gravitational, strong, weak and electromagnetic (electroweak) forces. The role of Great Unification Theory of these elementary forces in the evolution of the Universe is depicted in Figure 2.

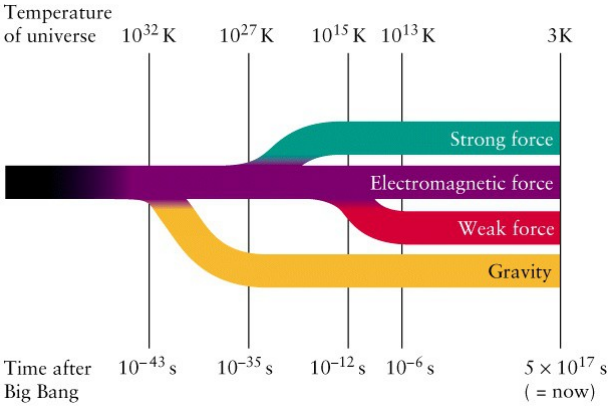

Fig. 2: Birth and evolution of the Universe

2.3 Models of Creation of the Universe

Because we do not have any quantum theory of gravitation a number of models of creation of the Universe with the following characteristics have been proposed, e.g.:

- Quantum model (Hartle & Hawking, 1983)
  - *creation from 'nothing'*, ex nihilo
- Noncommutative geometry (Heller et al., 1996) - *beginning is everywhere*
- String theory (M-theory, Witten, 1995) -
  collision of branes
- Cyclic (ekpyrotic) model (Steinhardt & Turok, 2002) - *big bangs and crunches*
- Eternal chaotic inflation (Linde, 1986) -
  bouble of universes

Please note that below the Planck threshold (in space and time of 10^{-35} m and 10^{-43} s) any time has been formally eliminated in the quantum model. Alternatively, these critical values correspond to a phase transition from commutative to noncommutative regime. Admittedly, in the last two models the time is *eternal*, but these models are difficult to be verified according to the criterion of falsifiability required for any scientific theory (Karl R. Popper).

2.3.1 String theory

It is worth noting that some of the best scholars in physics are working on a new theory of space, time, and matter, called "string theory", that may help us better understand where the universe came from. String theory is based on new ideas that have not yet been tested. The theory assumes, for example, that the basic particles in nature are not point particles, but are shaped like strings.

The theory requires – and predicts – that space has **more** than the **three** dimensions in which we move. According to one version of the theory, the particles and forces that make up our world are confined to three dimensions we see — except for gravity, which can "leak" out into the extra dimensions.

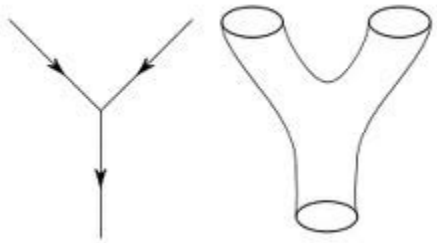

Fig. 3: Elementary interactions in the Standard Model and in string theory

This (super)string theory has led to some bizarre new scenarios for the origin of the universe. In one scenario, the Big Bang could have been triggered when our own universe **collided** with a "parallel universe" made of these extra dimensions.

Interaction in the subatomic world: world lines of point-like particles in the Standard Model or a world sheet swept up by closed strings in string theory are shown in Figure 3. Scenarios like these are very speculative, because the string theory is still in development and remains untested, but they stimulate astronomers to look for new forms of evidence.

3. NONLINEAR DYNAMICS AND FRACTALS

3.1 Deterministic Chaos

CHAOS (χαος) according to Strogatz (1994) is (see an excellent popular book by Stewart,1990):

- NON-PERIODIC long-term behavior
- in a DETERMINISTIC system
- that exhibits SENSITIVITY TO INITIAL CONDITIONS.

This means that there is a fixed distance r such that no matter how precisely one specify an initial state there is a nearby state (at least one) that gets a distance r away.

One example is dynamics of irregular flows in viscous fluids, which is still not sufficiently well understood. It appears that behavior of this system can rather be complex: from equilibrium or regular (periodic) motion, through intermittency (where irregular and regular motions are intertwined) to nonperiodic behavior. Two types of such nonperiodic flows are possible, namely chaotic and hyperchaotic motions. As discovered by Lorenz (1963), deterministic chaos exhibits sensitivity to initial conditions leading to unpredictability of the long-term behavior of the system (butterfly effect). Please note that in the original paper by Lorenz (1963) the term *chaos* has not yet appeared, but *nonperiodic* behavior is used instead. In a simple model of three ordinary nonlinear differential equations

$$\mathrm{d}X/\mathrm{d}t = \sigma(Y - X)$$
$$\mathrm{d}Y/\mathrm{d}t = -XZ + rX - Y$$
$$\mathrm{d}Z/\mathrm{d}t = XY - bZ$$

for some values of the model parameters, r =28, σ=10, b=8/3, the solution is *nonperiodic* as illustrated in Figure 4 and *sensistive* to initial conditions (resulting from the lack of Lyapunov stability). It is worth noting that for the first time we see here an asymptotic solution in a form of a *strange attractor* that has fractal structure presented in Figure 4.

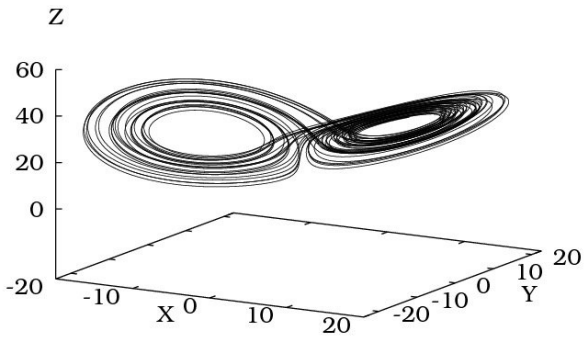

Fig. 4: Strange attractor

H*yperchaos* is a more complex nonperiodic flow, which is recently discovered in the generalized Lorenz model previously proposed by Macek and Strumik (2014). The results of the present paper illustrate how all these complex motions can be studied by analyzing this simple model. In particular, it is shown that various kinds of complex behavior are closely neighbored depending on two control parameters of the model.

Naturally, the convection appears in plasmas, where electrically charged particles interact with the magnetic field. Therefore, the obtained results could be important for explaining dynamical processes in solar sunspots, planetary and stellar liquid interiors, and possibly for plasmas in nuclear fusion devices.

4. IMPLICATIONS FOR COSMOLOGY AND CREATION OF THE UNIVERSE

- **Nonlinear** systems exhibit complex phenomena, including bifurcation, intermittency, and chaos.
- Fractals can describe complex shapes in the real word.
- Strange chaotic attractors have fractal structure and are sensitive to initial conditions.
- Within the complex dynamics of the fluctuating intermittent parameters of turbulent media there is a detectable, hidden ORDER described by a generalized Cantor set that exhibits a multifractal structure.
- Based on that scientific experience we argue here that **a simple** but possibly **nonlinear law** (cf. Macek, 2000), within theory of **chaos** and (multi-)fractals, can describe a hidden ORDER for creation of **Cosmos,** at the Planck epoch, where both *space* (at scale of 10^{-35} m) and *time* (10^{-43}s) were originated**.**

5.1 The Universe and Sense

For Heller the whole universe is the unique Word of God that gives **sense** to man, history, and the world (Heller, 2010). Reason that was at the beginning penetrates every being; existence results from rationality of Divine Thought. Naturally, he is convinced that faith should not be in separation from science. For Heller science as a whole is a *locus theologicus*.

Certainly, as every being also the universe requires some justification of existence. We ought to look for the sense of the world in the mystery of rationality; the sense given by God to every existing being is the **justification** of the universe.

That is why we can experience that really something **does** exist instead of nothing (cf. G. W. Leibniz).

- We should note a certain relation of the universe to **thought**. Surprisingly enough, nevertheless human thinking is limited to a relatively very short time, now it allows us to recover the whole cosmic history, which began about 14 billions years ago. Moreover, the human values can be realized in the context of the universe, which is an incarnation of a sensible thought.
- We are deeply immersed in the universe, since a life has appeared during the evolution of the Solar System (3.8 billions years ago) followed by a first **brain** awareness event, i.e., when the first man was born.
- Moreover, the human individuals are able to act following their own **will** and thoughts, including feelings that are very characteristic for our life. Therefore, any choice of sense is a demand of **rationality**, because the rejection of the sense should be considered as a betrayal of the human reason. In this way, when asking about the sense, we are also asking about God, who is continuously providing the sense to the whole universe.

• In scientific studies of the dynamical systems one of the most intriguing problems is the question of **reversibility**, or strictly speaking the problem of the time arrow, which is related to the statistical law of thermodynamical entropy.

This means that the present moment is always separated from the future and naturally from the past; consequently the world is historical. Basically, we all know that it is not possible to go back into the past. In particular, our biological clock is a special case of the thermodynamic clock. Unfortunately, when the entropy achieves its maximum every complex organism will die. Therefore, the **death** is not only a private tragic event, but it could be regarded as a participation in the cosmic structure.

- It is now clear that there should be **no** contradiction between
  - evolution and creation
    (in favor of evolutionary creationism),
  - determinism and indeterminism
    (in view of deterministic chaos theory and quantum mechanics).

  Obviously, a spiritual and moral evolution of every man depend on himself. Therefore, following critical **rationalism** of Popper, Heller has also noticed that decision of being rational in a human life is a moral choice. Rationality then becomes morality of thinking.

6. EPILOGUE

- We argue that the scientific theories of **nonlinear** dynamics, *chaos* and *fractals* help us to understand the origin of the Universe, see Figure 12 in (Macek, 2013), adopted from *Bible moralisée* (1220-1230) by Mandelbrot (1982).
- We also believe that the modern concept of the theology of science can certainly BRIDGE SCIENCE AND RELIGION, which gives **sense** of life (Macek, 2010, 2011).
- We argue that if we do not like to continue philosophical and theological studies in separation from science, then the philosophy of science and classic theology should open their thought to the most important ideas and achievements of the mathematical natural **sciences.**
- Therefore, we hope that this would admit a better understanding sense of man in his relation to the Universe and to the transcendent **Reality**.

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