



EVOLUTION OF SELF-REGULATED DYNAMIC SYSTEM IN THE THEORY OF POPULATIONS OF FAMILIES OF SMALL BODIES

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Abstract: Over the time, all types of matter have the ability to adapt to changes in the environment surrounding them. In particular, in the formation and birth of anomalous phenomena of nature, the Sun, the planets, the Moon and the entire universe take an active part. These processes occur under the influence of the following two forces:

1. Forces, whose sum of actions is measured by modern measuring instruments -

$$\sum_{i=1}^n F_i(x, t), \quad (n < \infty, x \in (x_i, x_{i+1}), t \in (t_i, t_{i+1})).$$

2. Forces, whose sums of actions are equal to or less than the errors of modern equipment-

$$\sum_{j=1}^n R_j(x, t), \quad (n = \infty, x \in (x_i, x_{i+1}), t \in (t_i, t_{i+1})).$$

Their participation in all observed phenomena and processes is hidden since they are usually elusive. They are detected as resonance anomalous phenomena and appear at frequency commensurabilities, at certain instants of time for certain configurations of the trajectories of the system elements for populations of families of small bodies. The examples consider the evolution in a long time observable automated dynamic processes. They are continuously associated with changes in the Earth's parameters in all geological time intervals and do not depend on the accuracy of the observation apparatus. They depend only on the evolution of natural processes and phenomena. Example of such process is formation of the most complex climatic formations in the atmosphere, together with the behavior of ocean currents on the surface of the Earth.

Key words: self-regulated dynamic system; mathematical modeling; population of small bodies.

1. Introduction. It is known [1; 9], that the sun, moon and the whole universe is involved in the formation and evolution of both external shape and internal structure of the Earth and other bodies. These processes take place under the influence of two forces: 1) forces, sum of which are greater than the sum of the errors of observed assessments (values). They always countable and can be expressed as:

$$\sum_{i=1}^n F_i(x, t), \quad (n < \infty, x \in (x_i, x_{i+1}), t \in (t_i, t_{i+1})).$$

They are identifiable with the help of mathematical modeling. All the known patterns that allow us to look both into the past and into the future of the observed natural phenomena are based on changes of allocation of the forces of interaction:

$$F = \sum_{i=1}^n F_i(x, t).$$

2) Forces, sum of which are less than the observational errors. These forces are hidden and are involved in all of abnormal phenomena. They are elusive. The birth of all the anomalous phenomena in nature was associated with discrete changes in force: $R = \sum_{i=1}^n R_i(x, t)$. The discreteness of the change in the forces R is based on the equality of the frequencies of the motions of certain elements of the system at certain



instants of time, t , in specific configurations of the elements of the automated dynamic system of bodies.

Their amount can be expressed as: $\sum_{j=1}^n R_j(x, t)$. For all dynamic systems the following equality is true: $\min\left(\sum_{i=1}^n F_i(x, t)\right) = \max\left(\sum_{j=1}^n R_j(x, t)\right)$. In other words [1; 2], $\sum_{j=1}^n R_j(x, t) \leq O - C < \sum_{i=1}^n F_i(x, t)$, where O – the result of estimates found from observations, C – the result obtained from the calculation according to the formulas of mathematical modeling. The sum $\sum_{j=1}^n R_j(x, t)$ displays itself only when resonance phenomena formed between some of its components i.e. when the frequencies of components phenomena become commensurable. Such phenomena is abnormal phenomena of nature and expressed in the form of chaos or catastrophe. Everything that happens in the universe is under the influence of these two sums of forces. In $F = \sum_{i=1}^n F_i(x, t)$, $(n < \infty)$, F – is a limited sum. All of the observed processes, phenomena, formation and development of the patterns in the nature are a reflection of this function. $R = \sum_{j=1}^n R_j(x, t)$, is the sum of infinitesimal actions (disturbances). All abnormal phenomena, processes, formation and development of patterns of disasters is a reflection of actions of this sum. This happens when the frequency of components of the sum become commensurable. Under the influence of forces $K(x, t) = \sum_{i=1}^n F_i(x, t) + \sum_{j=1}^n R_j(x, t)$, all bodies in the universe are in a state of great tension. Characteristic indicators of space regions are also subject to such impacts. This often is observed in abnormal natural phenomena such as earthquakes, volcanic eruptions, tsunamis, etc. if the Earth is considered as an example.

In [3], it is shown that if we take for granted the principle observed in the nature, that “variability of the process of cyclic formation, distribution and evolution of mass and energy is constant, then the absence of the beginning and the end of time, i.e. absence of birth of nature, can be proved”. This implies that in the nature, observed objects, processes, phenomena, including chaos and catastrophe, exist as a flow of huge waterfall. Such compactness of bodies, processes and events in time, can only exist if they are connected and organized as unified self-regulated system, which is managed by patterns of birth, existence, evolution, chaos and catastrophes. In this paper, as an example, the dynamic system, the basic properties of which coincide with the main characteristic parameters of the observed Solar System is considered. These properties are as follows [4]:

- 1) The orbits of all the planets are in the Solar equatorial plane;
- 2) The planets move around the Sun in orbits close to circular;
- 3) The direction of rotation around the Sun is the same for all the planets and



coincides with the direction of rotation of the Sun and planets' own rotation (except Venus and Uranus) around the axes;

4) 99.8% of the mass of the Solar system falls on the Sun and 0.2% for the planets, while the planets have 98% of the angular momentum throughout the Solar system;

5) Planets are divided into two groups, sharply differing in the average density. This is the first example of self-regulated dynamic systems.

2. Boundary values of the evolution of stable self-regulated Dynamic system in the mathematical models of the theory of families of populations of small bodies.

Comparative analysis of the results of observations of small Solar system bodies indicate that their orbits, depending on their initial conditions and the movement regions, can be divided into two groups: stable and unstable. According to the theory of stability of motion [5], stable orbits under small perturbations, maintain their state, while the unstable orbit are subject to dissipation of energy and can become a cause of joining with other objects, chaos and catastrophes. It is assumed that, there was a large fragment in the center of "Solar system", and there were fragments with stable orbits in the orbits of the planets. Bodies with unstable orbits, eventually, joined the central fragment and the fragments with stable orbits. Eventually, this led to formation of the Solar planetary system we observe today. This process is still ongoing in the form of counter-bombardment or joining small bodies with the Sun and the planets.

Analysis of the set of observed facts shows that the space of the currently existing Solar system could be filled with some of the fragments and their families [1, 6]. Central configurations observed in the present, various phenomena and processes comply with the applicable patterns of development. Mathematical modeling of these processes is the only key to unlocking truths, clarifying the past and the possible future of configurations of bodies, phenomena and processes we observe today. Each particle of the Solar system is in motion under the influence of the sum of the forces of both, the system itself and the Universe. Some of them are changing continuously, and others, as a result of a variety of chaos and catastrophes are of discrete nature. Various bodies of the solar system have different weights, sizes, locations, temperature, composition, internal structure and external forms, and they are in different aggregate states and energy. The observed state of the Solar system is a consequence of the patterns of development of the system, fragments and their evolution throughout its existence.

Thus, a space, i.e. the entire universe, divided into specific subspaces with stable and unstable properties. New objects are formed in them, with the special characteristic properties. This includes processes such as the birth of the Sun, the planets, including the planet Earth with all its features. For example, it took $(4,6 \pm 0,2) 10^9$ years for the formation of today observed Earth from primary fragments-clot-oddment of relict substance. As for how these processes occur in various embodiments, these phenomena were studied in detail in [1; 7-11], and in other studies of development of patterns, formation and evolution of the Earth, Solar system and Universe.



Normal and chaotic motions (including abnormal phenomena) are always nearby and the latter is subtly pursuing the former. They are usually subtle and manifest themselves only when the commensurability arises between the frequencies of components.

Dependencies between the mass and the temperature in its center, as well as the relationship between the amount of the central body mass and stability of orbits around the various bodies indicate the stability of self-regulated dynamic system. Therefore, the stable solar dynamic system we observe today is being formed during 10^9 years. At the same time, its stability can be destroyed because of the resonance between its components or because of entrance into it of external perturbing forces.

As a second example, let us consider the force of the Earth's impact, K . It can be represented in the form: $K = F + R$, where F is the sum of all the terms of the forces that can be taken into account by mathematical simulations. They satisfy condition

$$F > R = \sum_{i=n}^4 \Delta_i \text{ where } \sum_{i=1}^4 \Delta_i \text{ is the sum of the errors of measuring instruments: time}$$

Δ_1 , distance Δ_2 , mass Δ_3 and the sum of infinitesimal influences Δ_4 . The sum of infinitesimal influences is hidden and plays a decisive role in numerous elusive chaotic phenomena. When the frequencies of certain elements of the system's motion are equal, resonances and catastrophes are born. The formation of earthquakes, volcanic eruptions, landslides and numerous oceanic and atmospheric phenomena is the result of the addition of populations of sets of perturbing influences in the corresponding small families.

As a third example, consider those almost 200 countries that are located on the surface of the Earth. The birth and evolution of these countries are associated with the formation and evolution of populations of small families in these regions. Regulation and management of these populations is associated with a change in the set of conditions in these regions. With the evolution of conditions for the existence of regions, the characteristic indexes of populations of small families also change.

As a fourth example, the behavior of one embodiment of the process of the birth and evolution of a dynamical system is shown in figures 1-3. They are in good agreement with the earlier results of various authors [1; 7-11]. Detailed analysis of the choice of the initial conditions of the problem as well as the possible patterns of development of its various stages can be found in [9; 11].

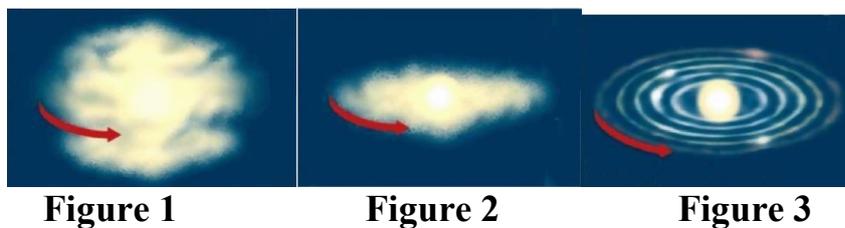


Figure 1

Figure 2

Figure 3

Figure 1-3 shows formation of cluster sets of populations of automated particles families, formation of cluster sets of populations of small bodies families and formation of stable automated dynamical system respectively



From figures 1-3, it follows that at the time of the formation and evolution of the observed Solar dynamic system it did not include the large disturbing objects. There were no major resonance phenomena between its components. Maybe there were some, but they were minor and had only local character. They did not have an impact on the dynamics of the processes of formation and evolution of the Solar system. This indicates on the purity of the path of the Solar system in Universe.

Conclusion:

Thus, it is shown that in self-regulated dynamical systems, populations of families of small bodies and the sum of infinitesimal actions can play a decisive role in the formation and production of anomalous phenomena. The sum of infinitesimal actions, which is less than or equal to the errors in the measurement of observations, is implicit in all phenomena and processes. It is only noticeable when the frequencies of some elements of the system are equal, with specific configurations of their trajectories at certain points in time. Such is the formation of the most complex climatic formations in the atmosphere, together with the behavior of ocean currents on the surface of the Earth. In these processes, a significant role can be played by the sum of infinitely small perturbations that are even or less than the errors of measuring instruments.

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