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№ 47
March, 2021

THE ISSUE CONTAINS:

Proceedings of the 2nd International Scientific and Practical Conference

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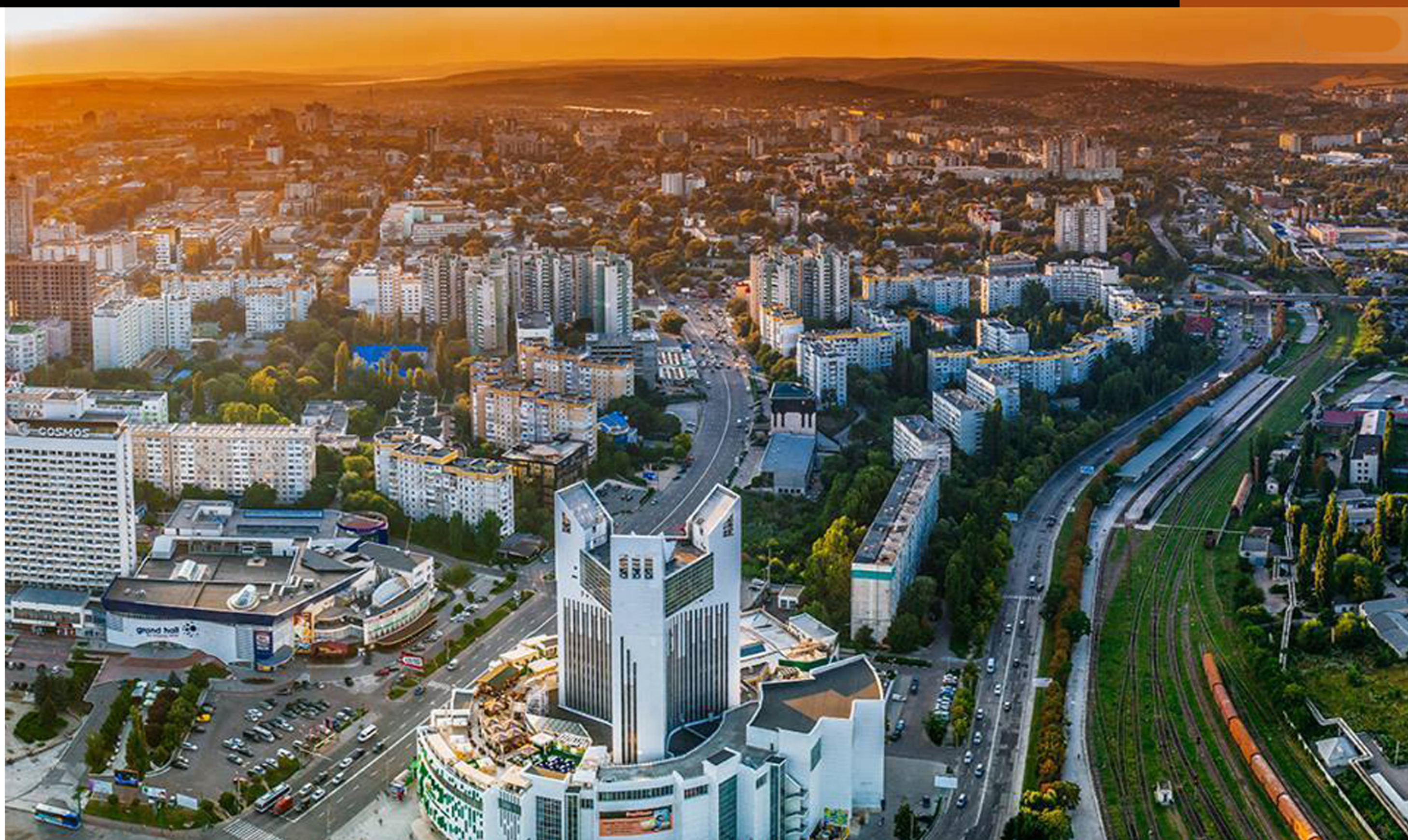

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ASTRONOMY, SPACE AND AVIATION

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TIME IN MATHEMATICAL MODELLING OF THE THEORY OF EVOLUTION OF VARIABILITY IN NONLINEAR DYNAMICAL SYSTEMS

Abstract. *The connection of the history of birth and evolution of the observed nonlinear dynamical systems with the history of time is considered. Examples of these are both normal and abnormal variability. Time builds dynamic systems from them. The sun and other objects are building materials, or different parts of dynamic systems. When time is stopped, dynamic systems stop working.*
Keywords: *dynamical systems, time, evolution, anomalous phenomena,*

Introduction

The motion of any particle of a dynamic system can be represented and studied using differential equations in the form [1-6]:

$$\frac{dx_i}{dt} = \dot{\bar{x}}_i = \bar{v}_i,\ \dot{\bar{v}}_i = -\frac{1}{m}\frac{\partial U}{\partial x_i}, \tag{1}$$

where

$$U = -\frac{G}{2}\sum_{i\neq j}^{n}\frac{m_i, m_j}{\|\bar{x}_i\text{-}\bar{x}_j\|}\ ,(i = \overline{1,\mathrm{n}}) \tag{2}$$

Which can be rewritten as:

$$U = U_0 + U_1 + U_2 + \cdots + U_n. \tag{3}$$

n – this is the number of particles, m_i,$\bar{x}_i$,$\bar{v}_i$*- mass, coordinates and velocities of* i*-th particle; U - potential energy of a dynamical system,* $\frac{\partial U}{\partial x_i}$ *– gradient from U relatively to* x_i, $\|x\| = \sqrt{<xx>} = \sqrt{x_1^2 + x_2^2 + x_1^2}$ *; G - gravitational constant.*

Sometimes the system of differential equations (1) is more convenient to represent in the form [7-12]:

$$\frac{dq_i}{dt} = \frac{\partial H}{\partial p_i}, \frac{dp_i}{dt} = -\frac{\partial H}{\partial q_i}; \quad \text{where, } (\bar{q}_i, \bar{p}_i) = (x_i, m_i\, v_i) \qquad (4)$$

Initial conditions: $\bar{x}_i(0) = \bar{x}_i^0, v_i(0) = \bar{v}_i^0$.

Where

$$H = \sum_{i=1}^{n} \frac{\|p_i\|}{2m_i} - \frac{G}{2} \sum_{i \neq j=1}^{n} \frac{m_i m_j}{\|q_i - q_j\|} \qquad (5)$$

Which can be rewritten as:

$$H = H_0 + H_1 + H_2 + \cdots + H_n \qquad (6)$$

Expressions (3) and (6) are more convenient to use for comparative Fourier analyzes of individual small perturbations.

The system of differential equations (1) and (5) combines the time t corresponding to different dynamical systems since each dynamic system has its own units of time measurement. Despite this, a single combination of both objects and processes in the entire Universe corresponds to each instant of time.

The observable Universe is a unified, self-governing, nonlinear dynamic system. It consists of similar self-governing sets of systems. Each of them is characterized by variability in the sum of the characteristic indicators. From the beginning (from the date of birth) to the end of the period of existence, the evolution of a dynamical system is governed by time.

On the evolution of processes in the theory of variability of nonlinear dynamical systems.

Comparative analyzes of statistical data shows that the significance of the forms of matter changes and this is associated with time. The maturation of all types of natural resources, that is charging of all processes always takes time.

In a symbolic space, in symbolic simulations, focusing on an individual element may be acceptable and appropriate. Time is such an element.

Both normal and abnormal processes of the system need Time. For some events, a split second is enough, while others need centuries, millennia and beyond. In other words, every moment of the Universe has its own unique moment in history that does not age with time. And this moment unites the Universe as a single living organism. Thus, Time controls variability. Time brings up by numerous examples.

Time works by the movements of all objects through the characteristic indicators of the dynamic system.

All dynamical systems have their beginning and end. These are examples of all observed dynamical systems.

All observed processes are in motion in time. In this multitude of events, resonant phenomena occupy a special place. They play the controlling role of sparks, followed by fires, explosions and other anomalous changes in the fate of a dynamic system. Their exact time, exact location and birth force are unpredictable. They are possible only at moments in time when the frequencies of movements of nearby objects are commensurate. These moments are different from others with their chaos and catastrophes, the consequences of which are the fireworks of the continuous variability of matter. All types of matter have the properties to adapt to the laws of the evolution of the environment. For example, in the solar system, the environment of only planet Earth allows the birth and evolution of matter in an currently observable living form. Her existence is subjected to various tests. The formation process of the coronavirus infection COVID-19 is also such an example. With some changes in the parameters of the sphere of influence of the solar system, the Earth would become one of the ordinary objects of this dynamic system. In particular, it could be influenced by the resonant phenomenon of the parade of planets. In this work, the question is considered, is it possible to understand the beginning and end of the continuous variability of matter and time? Observable particles, objects, dynamical systems and processes have their own lifetimes. Each state of the lifetime of a family of particles corresponds to unique moments in time. This is confirmed by the continuous formation of corals. Thus, time allows for a comparative analysis of historically valuable facts (effects), and unites the continuous variability of the processes of motion of families of particles in various dynamical systems and throughout the Universe.

Conclusion.

Thus, the history of the observed time is rigidly connected with the history of the birth and evolution of the observed dynamical systems. All kinds of variability: earthquakes, volcanic eruptions, numerous oceanic and atmospheric phenomena, etc. are such examples. For time they are like building materials, or parts of the universe. Time builds the universe. When time stops, the Universe stops working.

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