

Internal Structure and Magnetic Field of the Earth

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Abstract: *The article describes the internal structure of the Earth and models the processes that ensure the existence of the Earth's magnetic field. It is shown that the creation of substances in the core and the radiation processes that occur at the same time contribute to the heating of the inner regions of the Earth and the flow of light atoms from the core to the magma, which contributes to the formation of a thin layer between the core and the magma. This layer periodically changes its density due to the flow of light atoms from the core and the subduction of lithospheric plates. Electric charges caused by charged particles flowing from the nucleus are localized at the boundary of the density change. The rotation of the Earth causes electric currents to appear on the two surfaces of the thin layer, as a result of which the Earth's magnetic field arises. A thin layer unevenly covers the surface of the core, as a result of which the Earth's magnetic and geometric axes do not coincide. The movement of the substance of the layer on the core's surface causes the movement of the magnetic poles.*

Keywords: *UMIE model, the structure of the Earth's core, the birth of matter, radiation processes in the Earth, the flow of matter from the core to the mantle, subduction of the lithosphere, the Earth's magnetic field.*

1. INTRODUCTION

When considering all the great efforts to understand the mechanisms and processes that take place in the bowels of the Earth, one gets the impression that specialists have a variety of approaches to the specified problem. This approach should be based on the Universe's creation and evolution mechanisms. It could be the Standard Model [1, 2, 3], which has been developing for many decades. Alternative models could be used. Finally, you can use the model of the creation and evolution of the Universe with minimum initial entropy (UMIE), developed by the author of this article [4, 5].

Much attention was paid to developing the Standard Model of creating the Universe. Since the laws and principles underlying this model contradict the laws of physics [4, 5], its "improvements" appear to save the model (inflationary model; the problem of dark matter and dark energy; the birth of atoms more massive than an iron atom, etc.), which again violate the laws of physics. This situation with modelling the creation of the Universe affects the understanding of the structure of the Earth and, in particular, the core of the Earth. In this regard, let's consider in detail, within the framework of the laws of physics, all the processes that caused the real structure of the Earth, as well as the processes taking place in it, to understand the nature of the Earth's magnetic field.

2. PROCESSES OF CREATION OF THE EARTH AND ITS MAGNETIC FIELD IN THE STANDARD MODEL

According to the Standard Model of the creation of the Universe, it arose from the Big Bang from a fundamental volume singularity, which contained energy equivalent to the entire future mass of the Universe, characterized by a very high temperature ($\sim 10^{28}$ K [6]). The initial entropy of such a Universe was extensive ($S_0 = 10^{88}$ J/K [7]).

As such a Universe expanded, quarks and leptons were first born, then protons and neutrons. The expansion of the Universe was accompanied by its cooling, resulting in electrons combined with protons, forming hydrogen atoms. The further expansion of the Universe caused fluctuations in the density of matter (the hydrogen cloud), which led to the creation of stars. The compression of matter

led to a significant increase in temperature in the central regions of stars and, as a result, the thermonuclear fusion of helium and heavier nuclei up to the core of an iron atom began. Further synthesis of heavier nuclei turned out to be energetically unprofitable. Perhaps for this reason, geologists believe that the Earth's core contains mainly iron atoms [8, 9].

Simulation of the processes of ultrasound reflection from layers at different depths in laboratory conditions made it possible to isolate the Earth's core and the lower mantle, upper mantle, and lithosphere. The ultrasound's reflection from each sphere's surface made it possible to model its composition and state. At the same time, the ultrasound reflection from the Earth's core allowed us to assume that the Earth's core consists of a mixture of substances, more precisely: iron ~85%, nickel ~10%, and silicon ~5%.

The radius of the core is 3486 km. In addition, an inner core with a radius of 1216 km and an outer core are distinguished. The inner core is solid, and the outer core is liquid. This follows because transverse waves practically do not pass through the outer core, and anisotropy characteristic of the crystal structure was found for the inner core. In addition, there is an opinion that heavy radioactive nuclei, including uranium, exist in the Earth's core [10].

To explain the existence of heavy nuclei in the volume of the Earth (from iron to plutonium), scientists declared that such nuclei arise during explosions of supernovae. As a result of these explosions, dust clouds, meteorites, asteroids, etc., exist in space. Of course, there is no confirmation of this opinion. Moreover, such a model corresponds to reality since every star has a planetary system, and supernova explosions are rare.

It is easy to show that thermonuclear reactions in stars can only theoretically create nuclei of iron atoms, but in practice, this is unrealistic. Nevertheless, in the Standard Model, such a mechanism for the formation of atoms is considered proven by default. And if nuclei of oxygen atoms are born in stars, they eventually turn into oxygen atoms and, interacting with hydrogen atoms, form water molecules.

Of course, such a model has many significant drawbacks. First, the calculation shows that at the birth of the Universe, its gravitational radius should have been 7 billion light years! That is, the Universe must immediately be inside a black hole. Secondly, the contraction of hydrogen clouds into massive stars requires a decrease in the entropy of the Universe, which contradicts the second law of thermodynamics. Thirdly, when a substance explodes, the total momentum is zero. What made the stars rotate around their axis and also rotate around the center of the galaxy, which appeared for an unknown reason?

Further, it turns out that even in thermonuclear stars, the temperature in the center exceeds 10^9 K, and the reactions of the synthesis of heavy nuclei (to the iron nucleus) proceed very slowly. Therefore, during the existence of the Universe, synthesis processes did not reach the creation of iron atoms. In stars like our Sun, the thermonuclear reaction in its center can provide only the simplest nucleosynthesis reaction, in which four protons fuse into a helium nucleus. This is because the temperature in the Sun's center can reach $15 \cdot 10^6$ K, and the nucleosynthesis reaction occurs at temperatures of $(10 \div 14) \cdot 10^6$ K. In addition, if the reaction occurs only in the central part of the Sun, then helium atoms could reach its surface and would not come out yet. In this case, it is necessary to answer the question: why the proportion of helium on the surface of the Sun is ~25%; where did oxygen (0.77%), carbon (0.29%), iron (0.16%), neon (0.12%), nitrogen (0.09%), silicon (0.07 %) and other chemical elements? [11]?

As for the assumption about the birth of heavy atoms, in particular uranium and plutonium, during supernova explosions, one can discover light and heavy nuclei of chemical elements in the volume of the star. At the same time, according to the classical Maxwell-Boltzmann distribution, heavy nuclei are concentrated in the central regions of the star, while its surface consists of relatively light nuclei, mainly hydrogen and helium. The entire volume of the star contains only conductive plasma due to the high temperature. With a sufficiently large mass of the star, the pressure and the Fermi level in its center will rise so high that the energy of the electrons can reach the difference between the rest energies of the neutron and the proton ($1.29332 \text{ MeV}/c^2 = 2.531 \cdot m_e$), causing the combination of an electron with a proton and the formation of a neutron. Volume of matter will decrease in the center of the star. As a result, the plasma will flow to the center of the star with the formation of a neutron star core. The process will be uncontrolled. At the same time, a large kinetic energy is released, the front of which moves from the center to the surface of the star. At a certain moment, the kinetic energy

becomes equal to the potential energy of the near-surface layer of the star. It breaks this layer, giving it high energy and temperature. A flash occurs, which registers as a new star. Thus, the upper part of the star, represented mainly by light nuclei that cannot synthesize heavy nuclei, is thrown into space during supernova explosions. Therefore, the specified assumption about the birth of heavy nuclei does not correspond to reality. As a rule, astrophysicists believe that stars and planets are created from matter that arose as a result of supernova explosions. They rarely take into account all the processes that take place during the formation of stars from the very beginning, from the Big Bang. It turned out that near all stars there are planets that can contain the same chemical elements as on Earth. And it is known that Earth contains the entire table of chemical elements, including deposits of lead, mercury, gold, as well as uranium with impurities of plutonium. Thus, existing theories and models are unable to adequately explain the structure of the Universe, as well as the formation of chemical elements and their compounds.

As for the Earth's magnetic field, scientists believe that the liquid metal outer core that rotates around the Earth's geometric axis is responsible for its existence. It is easy to understand that the simple rotation of a liquid metal cannot cause a magnetic field to appear since this metal is electrically neutral. Therefore, electrons and atomic nuclei move with the same average speed, as a result of which the average value of the electric current is zero.

3. PROCESSES OF CREATION OF THE EARTH AND ITS MAGNETIC FIELD IN THE UMIE MODEL

In the new model, the problem of creating the formation of chemical elements and their compounds on Earth, as well as the appearance of the Earth's magnetic field, must be solved together with the problem of creating the nuclei of all chemical elements, as well as with the structure of the Earth's internal regions and the processes taking place inside the Earth.

The UMIE model considers all the laws of physics and uses the Laws of Unity and Similarity [4, 5]. This approach to developing a new model ensured the requirement that the radius of the Universe should be significantly greater than its gravitational radius at all times. To implement such a requirement, the Universe is imagined as a constituent part of the Super-Universe, represented by a layered space between the layers, in which there is only informational interaction through one delocalized point. These layers have different spatial dimensions: zero-dimensional space (World-1), one-dimensional space (World-2), two-dimensional space (World-3) and three-dimensional space (World-4). In addition, World-2 has two collapsed spatial dimensions, World-3 has one collapsed spatial dimension, and our World-4 has three collapsed spatial dimensions. Time and information dimensions are common to all layers of the layered space. These layers do not intersect and have separate spatial dimensions [4, 5].

This model shows particles and antiparticles were not born at once in the Universe. This is the property of the Scalar Field [12], which brings energy and the program for creating the Universe into the Universe. The Scalar Field can enter all layers of layered space. And that's why World-1 has 12 collapsed spatial dimensions. The Scalar Field has the same number of spatial dimensions. The Scalar Field enters through World-1, the collapsed coordinates of which form the rotational moment of the Field. It brings energy through World-1, and then it "flows" into World-2, and successively into World-3 and World-4. At the same time, World-4 begins to fill with particles not immediately but after a time of $3 \cdot 10^{-5}$ s. At the beginning of the filling of World-4, the density of matter has a value close to the nuclear density. The initial temperature of the born particles is zero. And hence the minimum value of entropy at the time of birth of World-4. The initial substance in World-4 turns out to be fragmented into the embryos of future stars, which receive a large rotational moment from the Scalar Field. Moreover, the matter in the Universe immediately has a fractal structure; that is, future stars' embryos are combined into future galaxies' embryos.

The Scalar Field generates dyons in World-2 - Planck particles with electric and magnetic charges. In World-3, the Scalar Field generates quarks; in our World-4, it generates baryons in the singlet state near existing nucleons [13]. All spaces expand simultaneously as branes of spaces with a larger number of spatial dimensions by one [14]. At the same time, the radii of these spaces increase with the speed of light. Being branes, all layers of layered space have finite volumes. Therefore, our Universe has a limited volume; that is, it is closed [15].

The Scalar Field creates particles and ensures that particles have mass. It ensures the annihilation of a particle with an antiparticle, thus creating a vacuum particle in which all quantum numbers are equal to zero [15]. Such a particle cannot absorb an electromagnetic wave. However, such absorption with

the formation of free particles and antiparticles is possible if a vacuum particle is polarized in a strong electrostatic field of atomic nuclei, which is observed in experiments. At the same time, virtual particles responsible for fundamental interactions can only be created by the Scalar Field.

And now, let's see what chemical elements would not exist if they were born due to thermonuclear fusion. These include known atoms: Ni, Cu, Zn, Se, Ag, Sn, W, Pt, Au, Hg, Pb, U, and Pu. There are entire deposits with a large content of these atoms, which allows them to be widely used in industry. So, how were they actually created?

The article [13] describes in detail the processes responsible for creating these atoms from the point of view of the UMIE model. Briefly, in our Universe (World-4), it looks like this. First, a space filled with vacuum particles is created. The radius of this space expands at the speed of light. Then the Scalar Field introduces energy into it, which generates bineutrons in the singlet state at a constant speed equal to 5000 solar masses per second [4, 5]. A large flow of the Scalar Field causes excitation of vacuum particles with the formation of particle-antiparticle pairs. New bineutrons are formed around existing nucleons. In this way, the mass of the initial embryos of future stars rapidly increases. A large excess of neutrons leads to radioactive decay by releasing electrons, protons, α -particles and free neutrons. This is how hydrogen and helium are formed. Part of the electrons and protons is thrown outside the nucleus, and the other part remains inside it. This is how heavy atomic nuclei arise, the charge of which in the first moments can significantly exceed the charge of uranium nuclei. An excess of neutrons in the composition of these nuclei leads to the well-known spontaneous decay of nuclei into lighter fragments. As a rule, daughter nuclei also turn out to be radioactive, resulting in the list of born chemical elements growing rapidly.

Over time, the total number of nucleons increases rapidly. Therefore, when energy is supplied at a constant rate, the probability of the birth of a bineutron in the vicinity of an atomic nucleus decreases, as a result of which a narrowed list of isotopes of atomic nuclei stabilizes. This is how all intermediate atomic nuclei from hydrogen to uranium are formed within the nucleus of a star.

When the stars were created, they rotated rapidly, increasing their mass constantly. Therefore, in the initial periods of its existence, the shape of the star was disc-like. The star's rapid rotation caused the detachment of peripheral areas with the formation of the embryos of future planets [16, 17], which should rotate around the star in its equatorial plane in one direction.

The second mechanism for forming atomic nuclei uses secondary nuclei born in the primary decay of heavy nuclei. In this case, the birth of a bineutron near secondary nuclei, particularly protons, will cause the appearance of tritium and light helium nuclei. Next, the chain of primary and secondary reactions will continue with the formation of heavier nuclei, particularly oxygen, nitrogen and argon, which make up the basis of the Earth's atmosphere. At the same time, under the conditions of the Earth, the main mass of oxygen is combined with hydrogen atoms (the Earth's hydrosphere), forming oxides of known elements that make up the basis of the Earth's lithosphere and magma. The list of relevant processes is given in the article [13].

Sometimes, the accumulation of heavy nuclei causes nuclear explosions, which are observed both on the Sun's surface and in the Earth's interior in the form of deep-focus earthquakes [18].

The same radiation processes occur in the Earth, resulting in the magma having a high temperature, at which the substance is in the state of a viscous liquid capable of transmitting transverse acoustic waves. In the liquid phase, the concentration of heavy atoms can occur due to the formation of crystals. This process is energetically beneficial. Since the surroundings of each crystal make it an open system, the excess entropy passes into the surrounding liquid. The creation of diamonds from carbon atoms confirms the existence of the process of crystallization of atoms in magma. When faults appear in the Earth's crust, diamonds come to the surface of the Earth.

When the core of the planet was created, there was no solid phase separation in its center yet. It appeared over time when the processes of crystallization began. This is how the inner solid core of the Earth arose, the volume of which increases over time. It cannot be a single crystal, since new matter continues to accumulate within its boundaries. Therefore, the core of the Earth should have a polycrystalline form, formed from atoms of different nature, from hydrogen atoms to uranium atoms.

Regarding the rotation of the inner core around its own axis, a lot of information appears, in particular, that the speed of its rotation does not correspond to the speed of rotation of the Earth. We

can agree with this since the outer core is liquid and does not really interfere with the specified difference in rotation speeds. However, one cannot categorically agree with the opinion of individual researchers that the direction of rotation of the core can change. This thought contradicts the laws of physics. Information [19] that the axis of rotation of the nucleus deviates from the Earth's axis of rotation by 0.17° is interesting. Such an effect can occur because the Earth's axis has precession and nutation. Currently, the axis is inclined to the orbital plane by 23.5° , but with a period of about 41 thousand years, the deviation of the Earth's axis varies from 24.5° to 22.1° . Since an outer liquid core surrounds the solid core, its axis must lag behind the Earth's axis of rotation, which causes the found deviation.

Light atoms can diffuse through the volume of the solid core and escape into the magma [20]. The created radioactive nuclei cannot move through the volume and form their own phase. However, remaining (α , β , γ , n)-radioactive, they contribute heat that enters the outer core and then into the magma. With distance from the center of the Earth, the pressure and temperature decrease, and the outer core acquires the state of a viscous liquid. It is clear that the property of the Earth's core to reflect acoustic waves can only be approximated by the combination of the three substances mentioned above.

The processes of the birth of new nuclei continue in the bowels of the Earth, and the radioactive decay of these nuclei continues. The presence of radioactive decay of chemical elements in the bowels of the Earth is easy to prove by analyzing the nature of gases dissolved in water at depths of several hundred meters. Here, we will notice the presence of inert gases, from helium to radioactive radon. Therefore, hydrogen and other light nuclei are constantly being born at great depths in the Earth.

Now, let's move on to the description of the processes that cause the appearance of the Earth's magnetic field and the possibility of replacing the magnetic poles. Of course, the Earth's magnetic field did not go unnoticed by researchers. However, they admit they still don't know why the planet's magnetic axis flips.

Continuing the study of the internal structure of the Earth, the authors of [21] saw that a thin but quite strong layer surrounds the outer core, the thickness of which varies within tens of kilometers (in [22], it is said that this layer is non-uniform in thickness and can reach 200 km). They hypothesized that this layer is the Earth's oceanic crust, which has descended over millions of years due to the presence of convection currents in subduction zones (subduction of lithospheric plates) to where it is today. On the other hand, as mentioned above, light atoms diffuse from the liquid core into the magma region [20], creating a zone of reduced substance density, the so-called Gutenberg gap. The thickness of this layer can exceed 100 km.

Now, to find out the reason for the appearance of the Earth's magnetic field, we will use the Laws of Unity and Similarity to describe the processes that take place between the liquid core and magma. Similarities can be found when considering the contact of two semiconductors or the electric field between the Earth's surface and the ionosphere. Therefore, a potential difference will be created in the region of the thin layer between the core and the magma; that is, electric charges will appear on the surfaces of the thin layer. The direction of the electric field will depend on the ratio of the density of matter in the layer, on the one hand, and in the core or magma, on the other. Charges with a certain surface density σ will be localized on the surface of the conductive outer core. Charges of different polarity will essentially be delocalized along the thickness at the boundary between the thin layer and the magma. However, for estimates, we will assume that these charges at the boundary of the thin layer and magma will be localized at a distance of $\Delta R = R_2 - R_1 = 100$ km from the Earth's outer core. The magnitudes of these charges are the same and equal

$$q = \sigma \cdot 4\pi R_1^2$$

The magnitude of the magnetic moment can be found using the formula

$$p_m = \frac{q}{3} (R_2^2 - R_1^2) \cdot \omega = 7,812 \cdot 10^{22} \text{ A} \cdot \text{m}^2$$

Since the value of the angular speed of rotation of the Earth is $\omega = 7.272 \cdot 10^{-5}$ rad/s, then the value $q = 4.6 \cdot 10^{15}$ C, which corresponds to $1.5 \cdot 10^{20}$ protons/m², or $\sigma = 24$ C/m². At the same time, the magnitude of the electric field in the thin layer can be within $10^6 \div 10^9$ V/m depending on the thickness of the layer. If we assume that the specific resistance of the substance in a thin layer is equal to $\rho = 10^{12}$

$\Omega \cdot m$, then the value of the current density in the layer will reach $j = 10^{-6} \div 10^{-3} \text{ A/m}^2$. This current must be compensated by the flow of charged particles from the core to the magma.

For comparison, let's pay attention to the fact that the intensity of the electric field in the Earth's atmosphere at low altitudes reaches $\sim 100 \text{ V/m}$ and decreases with increasing altitude, so that at an altitude of 50 km the electric field is already absent. At the same time, an electric current occurs with a density of $2 \cdot 10^{-12} \text{ A/m}^2$ [24]. Therefore, this field is much weaker than around the Earth's core, and will practically not affect the magnitude of the Earth's magnetic field.

The flow of light particles from the core to the magma must interact with the lithosphere over time, creating a prerequisite for the descent of parts of the lithosphere to the surface of the core [23], creating a thin layer with increased density and an electric field of the opposite direction. That is, the Earth's magnetic field is changing. It is theoretically shown in [23] that the half-period in switching the magnetic field should be 30-60 million years. At the moment, the density of matter in the layer is lowered due to the large contribution of light atoms.

Since the thickness of the layer around the Earth's core is not constant, this causes the divergence of the directions of the Earth's geometric and magnetic axes. The movement of the layer on the surface of the core causes the movement of the Earth's magnetic poles.

4. CONCLUSION

Based on consideration of the Earth's internal structure from the standpoint of the UMIE model, the following is shown.

1. The Earth's inner core has a solid polycrystalline structure, which includes almost all atoms of the periodic table of elements.
2. As the nutation of the Earth's axis occurs, it causes a shift in the axis of rotation of the inner core.
3. Radiation processes in the core not only contribute to the heating of the inner regions of the Earth but also cause the flow of light atoms into the magma.
4. The flow of light atoms causes a decrease in the density of matter in the thin layer between the core and the magma. This contributes to the appearance of electric charges on the inner and outer surface in this layer and the flow of direct current in this layer, stabilizing the magnitude of the electric field.
5. The rotation of the Earth around its own axis causes the appearance of an electric current along the direction of the Earth's rotation. The difference in the magnitude of the currents on the two surfaces of the layer ensures the appearance of the Earth's magnetic field. Switching the direction of the magnetic field is caused by two processes: the flow of charged particles from the core into the magma and the subduction of lithospheric plates, which contributes to an increase in the density of matter in the layer and a change in the direction of the magnetic field.
6. The Earth's geometric and magnetic axes do not coincide, because the thickness of the layer around the core is not constant. The displacement of the layer on the core's surface causes the movement of the magnetic poles.

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