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The Electrical Polarization of the Earth in Its Orbital Motion

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Abstract: In the course of its orbital motion, the Earth continuously crosses the magnetic field lines of the Sun. For this reason, the Earth is constantly exposed to the electromagnetic force, which is directed to the Sun. This force may cause the movement of the earth's positive charges in the direction of the Sun and the movement of the earth's negative charges in the opposite direction. Under the action of this force, the earth's electrical charges can move into space. Also, this power turns the Earth into an electric dipole whose axis is oriented along the line that connects the center of the Earth and the center of the Sun. The electrical polarization of the Earth affects the processes that occur on earth's surface.

Keywords: Solar Magnetic Field, Earth's Electrical Charge, Earth's Polarization, Earth's Annual Rotation

1. Introduction

There are two undeniable facts: 1. The Sun has a magnetic field; 2. The Earth revolves around the Sun. Solely from these facts the conclusion that the Earth is continually exposed to electromagnetic forces. Here the analysis of this force and its likely effect on the Earth.

2. Results

For definiteness, we choose a coordinate system in which the magnetic field lines of the Sun starts on its upper pole and end at its lower pole (Figure 1).

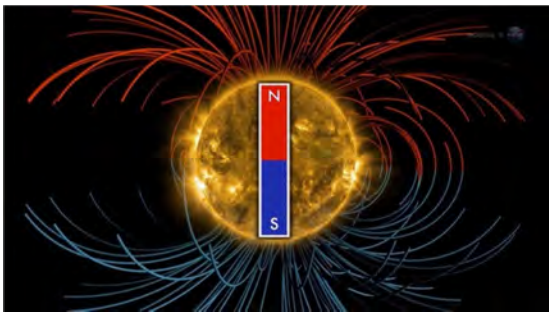

Figure 1. It is the magnet that simulates the magnetic field of the Sun. In the chosen coordinate system the magnetic field lines of the Sun starts on its upper pole and end at its lower pole.

The In this coordinate system, the Earth moves around the Sun in a counterclockwise direction (Figure 2). Also in this coordinate system the lines of force of the geomagnetic field starts at the South Pole and end at its North Pole.

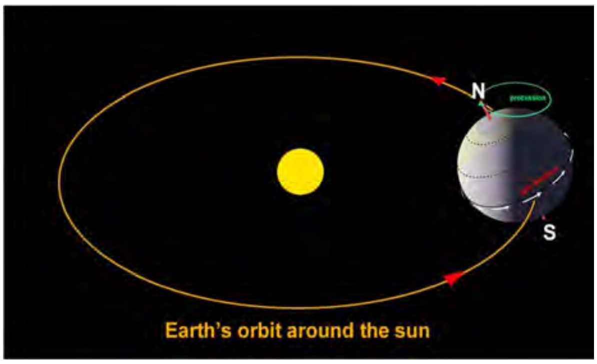

Figure 2. This is the annual Earth orbit: it is here assumed that the Earth revolves around the Sun counterclockwise (the direction of movement of the Earth is shown by red arrows).

It also shows the magnetic poles of the Earth and the direction of its daily rotation (this is shown by white arrows).

Given these conditions, it can be concluded that moving the Earth is constantly crosses lines of force, solar magnetic field. During such intersection the Lorenz force F_L acts steady on the Earth and, in particular, its electric charges. Given the Figure, it can be concluded that this force is directed towards the Sun, and its magnitude $|F_L|$ in this direction is:

$$|F_L| = q|v_E| \cdot \mu\mu_0|H_S| \qquad (1)$$

where: q – charge on the Earth;

v_E – the linear orbital speed of the Earth;

μ (= 1.0) – relative magnetic constant vacuum [1];

μ_0 (= 1,257•10^{-6} kg·m·s^{-2}·A^{-2}) – magnetic constant [1];

$/H_S/$ – the tension of solar magnetic field near the Earth.

It can be expected that the Lorentz force will distribute the charges of the Earth, – under its effect, the positive charges are concentrated on the illuminated side of the Earth, and negative charges will be concentrated on the dark side of the Earth. In addition, it can be assumed that under the action of this force the electric charges can leave the Earth. We made mathematical calculations to verify these assumptions.

In begin we have tried to define the value described Lorenz force F_L acted on the elementary earth's charge e. As is clear from equation (1), to define this value, we need to know both linear orbital speed of the Earth $|v_E|$, and tension of solar magnetic field near the Earth $|H_S|$.

As is accepted the middle orbital speed of the Earth $|v_E|$ is ~29800 m·s^{-1} [2]. Same timely, it is not precise defined the intensity of the Sun magnetic field at the Earth's orbit. To define this parameter, we propose to accept following assumptions and calculations.

As was the custom, in the chosen coordinate system the Sun and the Earth form a pair of differently directed magnets. In the selected coordinate system, the magnetic field lines of the Earth start at the South Pole and end on North Pole (Figures 1-3)

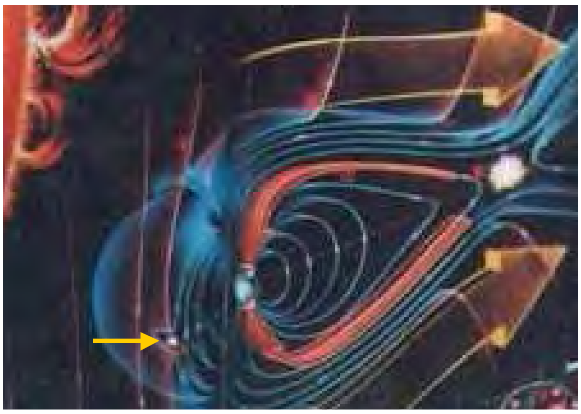

***Figure 3.** The interaction of solar (the pink arrows, left) and Earth's (the blue arrows, right) magnetic fields. The lines of force of solar magnetic field are down directed. The lines of force of Earth's magnetic field are up directed. They are equilibrating in front of magnetopause (the yellow arrow).*

Thus, the Sun and the Earth can be showed as contradictory directed magnets (it may be said that the Sun and the Earth form a typical magnetic chain). Therefore, the lines of force of solar and earth's magnetic fields have a 'like directions near the earth's poles (Figure 2): they are down directed in the area north geographic pole of the Earth and up directed near the earth's geographic south pole. It is also obvious (Figure 3) that earth's and solar magnetic fields are opposite directions near the equator line.

It is known that the tension of magnetic field near the poles is 0,65 A·m^{-1}, and its tension at equator line is 0,25 A·m^{-1} [1,2]. For this reason, we had concluded that the polar geomagnetic field is indeed a sum of solar and earth's magnetic fields and equatorial geomagnetic field is their difference.

In this manner, we had obtained two equations:

$$|H_E| + |H_S| = \sim 0{,}65\ A\cdot m^{-1} \qquad (2)$$

$$\text{and } |H_E| - |H_S| = \sim 0{,}25\ A\cdot m^{-1} \qquad (3)$$

where: $|H_E|$ – tension of earth's magnetic field;

$/H_S/$ – the tension of solar magnetic field near the Earth.

Differing these equations, we had obtained the significance of $|H_S|$ needed:

$2|H_S| = \sim 0{,}40\ A\cdot m^{-1} \Rightarrow |H_S| = \sim 0{,}2\ A\cdot m^{-1}$.

Summering these equations we had probable obtained the "pure" $|H_E|$:

$2|H_E| = \sim 0{,}90\ A\cdot m^{-1} \Rightarrow |H_E| = \sim 0{,}45\ A\cdot m^{-1}$.

Using obtained $|H_S|$, we calculated the force acted on an elementary charge $|F_L|$, via (1):

$|F_L| = q|v_E| \cdot \mu\mu_0|H_S|$ (1) =

= ~1,6•10^{-19} A·s•2,98•10^4 m·s^{-1} •1•1,257•10^{-6} kg·m·s^{-2} A^{-2}•0,2 A·m^{-1} = ~1,2•10^{-21} N.

where: e (= 1,6•10^{-19} A·s) – elementary charge [1];

$|v_E|$ (= ~2,98•10^4 m·s^{-1}) – linear orbital speed of the Earth;

μ (= 1.0) – relative magnetic constant vacuum [1];

μ_0 (= 1,257•10^{-6} kg·m·s^{-2} A^{-2}) – magnetic constant [1];

$|H_S|$ (= ~0,2 A·m^{-1}) – calculated tension of solar magnetic field near the Earth.

To characterize this force, we had defined the acceleration of single proton a_p undergoing the force:

$|a_p| = |F_L|/m_p$ = ~1,2•10^{-21} N / 1,66•10^{-27} kg = ~0,72•10^6 m·s^{-2} = ~720 km·s^{-2},

where: $|F_L|$ (= ~1,2•10^{-21} N) – described Lorenz force;

m_p (= ~1,66•10^{-27} kg) – mass of proton [1].

Thus, an isolated proton can move in the direction of the Sun with a speed of ~360 km in 1 second, at least theoretically. As upper atmosphere is positively charged [3-9], it can be assumed that its protons can theoretically leave the Earth.

It is obvious that similar calculations can be made as well for negative charges, in particular for electrons. Considering the electrical polarization of conductors is moving perpendicular to the magnetic field lines [1], it can be concluded about the negative electrification night side of the Earth. This allows to conclude that the Earth is an electric dipole whose axis is directed along the line connecting the centers of the Earth and the Sun. Developing this conclusion, it is also possible to conclude that due to the daily rotation of the Earth, the sign of the electric charge of the earth's surface, will change frequency is once per day. The sign of this charge is positive in daytime and negative at night. In any case, this should occur in non-polar regions of the Earth.

It should be noted that the day side of the Earth can acquire positive charge under the sunlight: it is known that positive charges always move in the direction of the Pointing vector, which defines the direction of propagation of light [10]. In addition, the positive electrification of the illuminated surface of the Earth can occur as a result of the photoelectric effect [11].

As well, the same polarization of the Earth is called the Lorentz force, which occurs when the movement of the earth's surface relative to the force lines of the geomagnetic field [9]; this is because the tension of the geomagnetic field day less than a night (Figure 3).

Thus, there are any reasons for the positive electrification of the illuminated side of the Earth. Surprisingly, all these causes are responsible for the positive charge on the illuminated side of the Earth.

3. Discussion

It is obvious that the periodic change of sign of the electric charge of the earth's surface must influence the processes that occur on Earth. This can be demonstrated on the example of the evaporation of aqueous solutions of some salts.

3.1. The Evaporation of Saline Solutions

Previously it was repeatedly shown that water vapor always has a positive charge, regardless of the conditions of evaporation [3-8]. Now it can be argued that only positively charged water can evaporate from the surface of the Earth [9]. It is obvious that the change in the magnitude of the positive charge of the Earth's surface have an effect on the evaporation of water and aqueous solutions under earth surface. That the effect exists, it is possible to make sure, watching the evaporation of salt solutions. These observations allow to establish that the rate of evaporation of aqueous solutions subject to significant fluctuations (Figure 4).

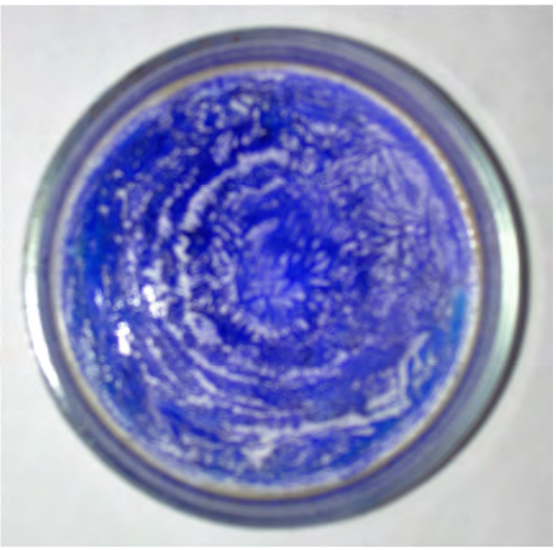

Figure 4. *It's a circle precipitation is formed upon drying of an aqueous solution of $CuSO_4$. Concentric location of salt crystals indicates that the evaporation occurred at different speeds. This salt solution was dried for four days at a temperature of 18 – 2°C.*

To obtain a deep blue color, the resulting crystals were treated with ammonia vapors. It is known that copper ions bind ammonia, with the formation of complexes intensively blue color [12].

To better understand the mechanism of formation of such concentric circles (Figure 4), it should also be noted that water with a negative electric charge has a smaller surface tension than water with a positive electric charge: as a consequence, negatively charged water wets the glass surface better than the positively charged water (Figure 5) [13]. Considering this feeling, you can be sure that it is not a solid salt of a circle alternating with circles, which are free from salt (Figure 4). This unevenness of the resulting sediment can be explained by the alternation of two electrical states under which:

1. Positive electrification of a solution is accompanied by a decrease its surface area and speeding up its evaporation;
2. The negative electrification of the solution is accompanied by increase in its surface area and the cessation of evaporation.

Figure 5. *Left: 5 ml of water with negative electric charge cover all the bottom of a Petri dish. Right: 5 ml of water with positive electric charge do not cover the bottom of a Petri dish; the surface of such water decreases rapidly after mixing [13].*

Therefore, the regular change of the sign of the charge of the earth's surface and objects on it are, has a visual confirmation. However, the uneven structure shown precipitate can be explained by fluctuations in the temperature of the solution, more traditionally.

3.2. The Rotation of the Flowing Water

At the same time, based on the traditional ideas, it is much harder to explain different directions of rotation of water flowing through the drain hole. (Any more or less careful observer has seen that flowing water rotates as clockwise and counterclockwise.) However, such a change of rotation direction of the flowing water is easily explained by the change in its electrical charge. To do this, consider a pattern: in the Northern hemisphere the flow of negatively charged the water spins clockwise (Figure 6, left), and the flow of positively charged water is twisted counterclockwise (Figure 6, right). (It should be recalled that a similar difference in the direction of rotation of charged particles moving along the magnetic field used in the mass spectrograph to determine the sign of the electric charge of the particles [11, 14].)

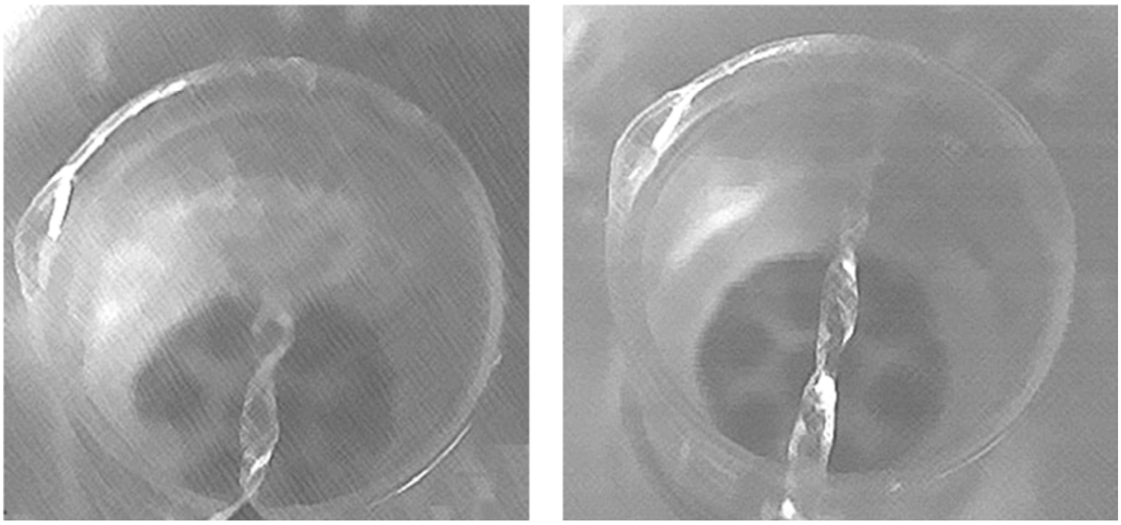

Figure 6. *Left: When water with a negative charge flows through a narrow crack, it twisted clockwise. Right: When water with a positive charge flows through a narrow crack, it twisted counterclockwise.*

Due to the significant surface tension forces, the cross section of the positively charged water tends to take the form of a circle. Due to the small surface tension forces, the cross section of negatively charged water retains the shape of the slit.

Considering that the water with a positive charge has a greater surface tension than water with a negative charge (Figure 5), it is also becoming clear noticeable difference in the cross-sectional shape of the resulting jets: cross-section of the jet of positively charged water tends to take the form of a circle (Figure 6, left), and the cross-section of the jet negatively charged water retains the shape of the slit (Figure 6, right). It is obvious that the greater the surface tension of water with a positive charge is stronger than seeks to reduce its cross-sectional area of the jet, the smaller the surface tension of water with a positive charge.

Thus, the periodic change of the direction of rotation of water flowing through the drain hole, clearly reflects the periodic change of the sign of the charge of the earth's surface. As you can see, there are a number of phenomena that reflect a change of sign of the charge of the earth's surface.

4. Conclusion

When moving along its orbit, the Earth is constantly crosses the lines of force of the solar magnetic field. For this reason, the Earth is constantly subject to the Lorentz force that is directed toward the Sun. This force polarizes the Earth: under its action the positive charges are concentrated in the lighted part of Earth, and negative charges are concentrated in its dark part. In addition, the same polarization of the Earth occurs under the influence of sunlight. The electrical polarization of the Earth affects the processes that occur on earth's surface.

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