Khmelnik S.I.

More About the Nature of the Earth's Magnetism

Abstract

A hypothesis of the Earth magnetism nature is presented and debated.

Contents

1. Introduction

The spherical capacitor in the direct-current circuit is discussed and Maxwell's equations for the spherical capacitor under charging are solved in [1]. It follows from this solution that after charging the capacitor, when the current practically stops, the stationary flow of electromagnetic energy remains in the capacitor, and the electromagnetic wave remains with the flow. Based on that, a hypothesis about the nature of Earth's magnetism is proposed in [1]. This hypothesis is justified and discussed in more detail further.

2. The Electromagnetic Wave in a Spherical Capacitor

Fig. 1 shows the spherical coordinate system (ρ, θ, φ). Next, the GHS system and the following notation is used:

$E_{\rho,\theta,\varphi}$ - electrical intensities,

$H_{\rho,\theta,\varphi}$ - magnetic intensities,

μ - absolute magnetic permeability,

ε - absolute dielectric constant.

In [1] it is shown that the intensity determined by the formulas given in the Table. 1, where

$$H_{\theta\rho} = \frac{A}{2\rho}\sin(q(\rho - R) + \beta), \qquad (1a)$$

$$H_{\varphi\rho} = \frac{-A}{2\rho}\cos(q(\rho - R) + \beta), \qquad (1в)$$

$$H_{\rho\rho} = \frac{-A}{q\rho^2}\cos(q(\rho - R) + \beta), \qquad (1c)$$

$$E_{\theta\rho} = \frac{Ag}{2\rho}\cos(q(\rho - R) + \beta), \qquad (2a)$$

$$E_{\varphi\rho} = \frac{Ag}{2\rho}\sin(q(\rho - R) + \beta), \qquad (2в)$$

$$E_{\rho\rho} = \frac{Ag}{q\rho^2}\sin(q(\rho - R) + \beta), \qquad (2c)$$

$$q = \frac{\omega\varepsilon}{c} g = \frac{\omega}{c}\sqrt{\mu\varepsilon}, \qquad (3a)$$

$$g = \sqrt{\mu/\varepsilon}\,. \qquad (3в)$$

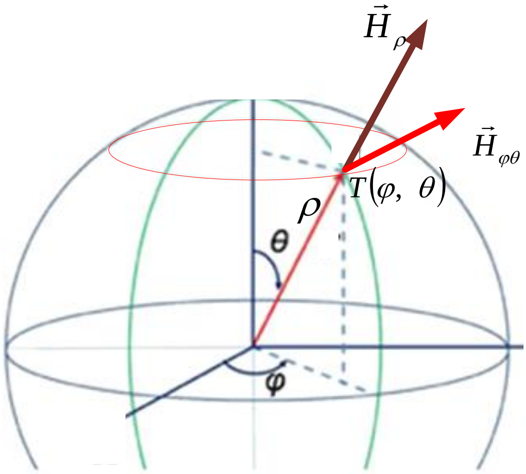

Fig. 1.

Table 1.

$E_\rho = E_{\rho\rho}(\rho)\cos(\theta)(1 - \exp(\omega t))$
$E_\theta = E_{\theta\rho}(\rho)\sin(\theta)(1 - \exp(\omega t))$
$E_\varphi = E_{\varphi\rho}(\rho)\sin(\theta)(1 - \exp(\omega t))$
$H_\rho = H_{\rho\rho}(\rho)\cos(\theta)(\exp(\omega t) - 1)$

$H_\theta = H_{\theta\rho}(\rho)\sin(\theta)(\exp(\omega t) - 1)$
$H_\varphi = H_{\varphi\rho}(\rho)\sin(\theta)(\exp(\omega t) - 1)$

Let us consider a point T with coordinates $\varphi,\ \theta$ on a sphere of radius ρ .Vectors E_φ and E_θ, going from this point are in plane P, tangent to this sphere at point $T(\varphi,\ \theta)$ - see Fig. 2. These vectors are perpendicular to each other. Hence, at each point $(\varphi,\ \theta)$ the sum vector

$$\vec{H}_{\varphi\theta} = \vec{H}_\varphi + \vec{H}_\theta \tag{4}$$

is in plane P and has an angle of ψ to a parallel line. In [1] it was shown that this vector and the angle ψ defined by the following formulas:

$$H_{\varphi\theta} = \left|\vec{H}_{\varphi\theta}\right| \sin(\theta)(\exp(\omega t) - 1), \tag{5}$$

$$\left|\vec{H}_{\varphi\theta}\right| = \frac{A}{2\rho}, \tag{6}$$

$$\psi = \frac{\pi}{2} - \frac{\omega}{c}(\rho - R) - \beta, \tag{7}$$

where $A,\ R,\ \omega,\ \beta,\ c$ are the coefficients that can be determined experimentally; R is the radius of the outer sphere of the capacitor. Coefficient $\omega = -\frac{1}{\tau}$, where τ is the characteristic time in the charge circuit of the capacitor.

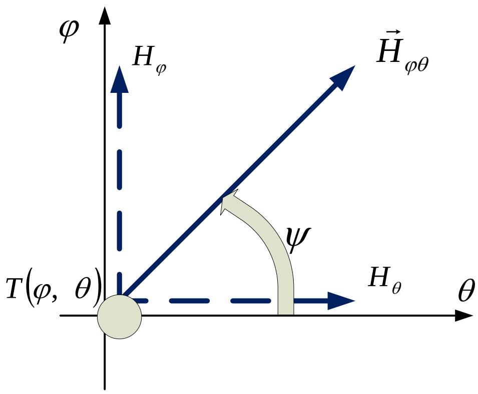

Fig. 2.

Similarly, the same relationships exist for the vectors $\vec{E}_\varphi$ and $\vec{E}_\theta$. Therefore, in a spherical capacitor we can consider only one vector of the electrical field intensities $\vec{E}_{\varphi\theta}$ and only one vector of the magnetic field intensities $\vec{H}_{\varphi\theta}$. As these vectors lie on the sphere, they will be called spherical vectors.

In Fig. 3 shows the vectors $\vec{H}_{\varphi\theta}$ and $\vec{E}_{\varphi\theta}$ lying in the plane P, and vectors $\vec{H}_\rho$ and $\vec{E}_\rho$ lying on a radius.

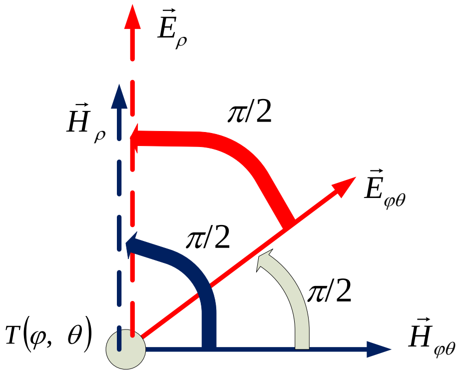

Fig. 3.

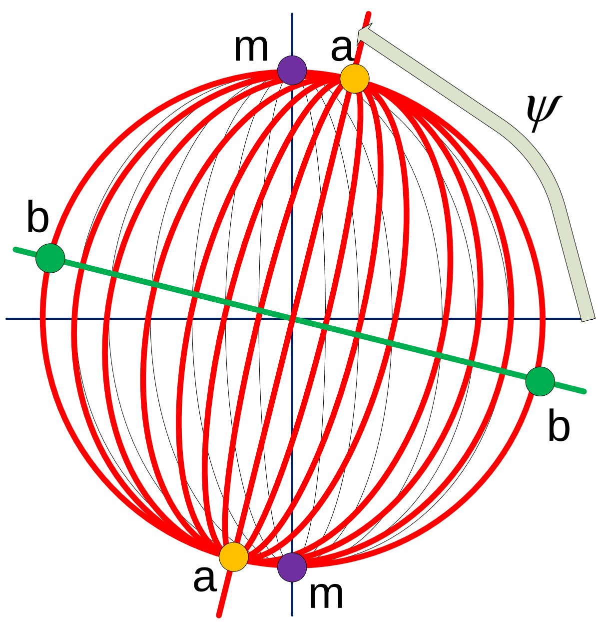

Fig. 4.

Angle ψ is constant for all vectors $\vec{H}_{\varphi\theta}$ for a given radius ρ. This means that the directions of all vectors $\vec{H}_{\varphi\theta}$ constitute the same angle ψ with all parallels on a sphere with a radius of ρ. This implies in turn that there are the magnetic equatorial plane inclined to the mathematical equatorial plane at angle ψ, magnetic axis, magnetic poles, and magnetic meridians, along which vectors $\vec{H}_{\varphi\theta}$ are directed – see Fig. 4, where thin lines mark the mathematical meridional grid, thick lines mark the magnetic meridional grid, the mathematical axis *mm*, and magnetic axis *aa* and electric axis *bb* are shown. It is important to note that the magnetic axis *aa*, electric axis *bb* and all vectors $\vec{E}_{\varphi\theta}$ и $\vec{H}_{\varphi\theta}$ are perpendicular.

When $\frac{\omega}{c} \approx 0$ and $\beta = 0$ the magnetic axis coincides with the mathematical axis.

3. The magnetic and electric field of the Earth

Next, we consider the hypothesis, that **the Earth electrical field is responsible for the Earth magnetic field.**

It is known that the Earth electrical field can be considered as a field "between spherical capacitor electrodes" [2]. These electrodes are the Earth surface having a negative charge and the ionosphere having a positive charge. The charge of these electrodes is maintained by continuous atmospheric thunderstorm activities.

It is also known that there is the Earth magnetic field. However, in this case no generally accepted explanation of the source of this field is available. "The problem of the origin and retaining of the field has not been solved as yet." [3].

Next, we consider the hypothesis, that **the Earth electrical field is responsible for the Earth magnetic field.**

It was shown above that there are the magnetic equatorial plane, magnetic axis, magnetic poles and magnetic meridians, along which vectors $\vec{H}_{\varphi\theta}$ are directed – see Fig. 4. The angle between the magnetic axis and the axis of the mathematical model can not be determined from the mathematical model. Moreover, not determined angle between the magnetic axis and the Earth's physical axis of rotation.

Spherical vectors depend on $\sin(\theta)$. Radial vectors depend on $\cos(\theta)$ – see Table 1. Therefore, there are the radial intensities only in locations where the spherical intensity is zero. We find the angle of inclination. From Table 1 and the formulas (3, 5, 6) it follows that

$$tg(\phi)=\frac{\left|\vec{H}_{\varphi\theta}\right|}{\left|\vec{H}_{\rho}\right|}=\frac{\frac{A}{2\rho}\sin(\theta)}{\frac{Ac}{\omega\rho^{2}}\cos(\theta)}=\frac{\omega\cdot\rho\cdot tg(\theta)}{2}. \qquad (8)$$

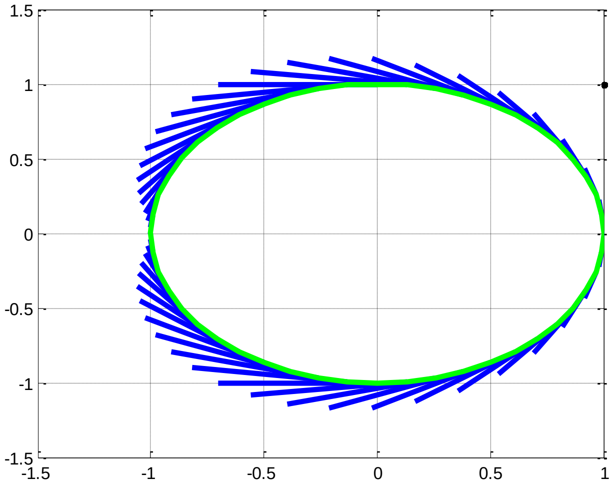

FIG. 8. (Sfera.88)

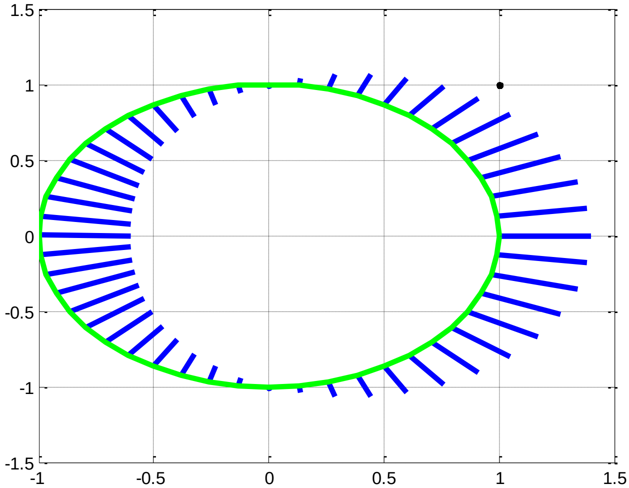

FIG. 9. (Sfera.88)

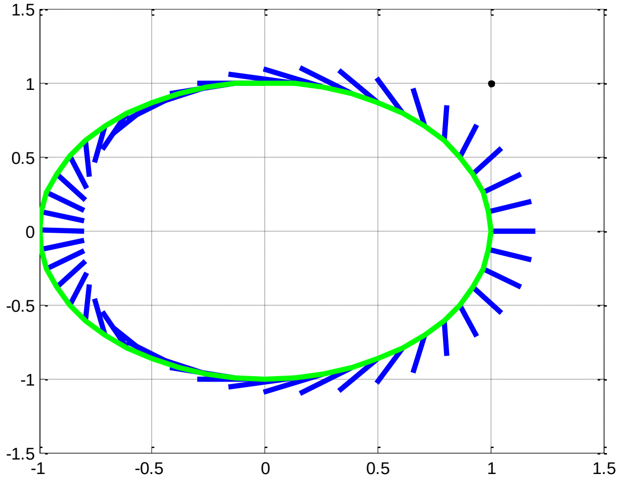

FIG. 10. (Sfera.88)

The vector field $\vec{H}_{\varphi\theta}$ in a diametral plane passing through the magnetic axis is shown in Fig. 8. Here, $\left|\vec{H}_{\varphi\theta}\right| = 0.7;\ \rho = 1$. The vector field $\vec{H}_{\rho}$ in a diametral plane passing through the magnetic axis is shown in Fig. 9. Here, $\left|\vec{H}_{\rho}\right| = 0.4;\ \rho = 1$. The vector field $\vec{H} = \vec{H}_{\varphi\theta} + \vec{H}_{\rho}$ in a diametral plane passing through the magnetic axis is shown in Fig. 10. Here, $\left|\vec{H}_{\varphi\theta}\right| = 0.3;\ \left|\vec{H}_{\rho}\right| = 0.2;\ \rho = 1$.

4. Discussion

Similarly, can be described the electric field of the Earth. Importantly, the electric field and the magnetic field are coaxial.

Once again, the very existence of the electric field is not in doubt, and the charge of "Earth's spherical capacitor" is supported by the thunderstorm activity [2].

Also consider the comparative quantitative estimates of magnetic and electric intensity of the Earth's field.

In a vacuum, where $\varepsilon = \mu = 1$, there is a relation between the magnetic and electric intensity in any direction in the GHS system [1]

$$E = H. \tag{9}$$

This relation is true if these intensities are measured in the GHS system at a given point in the same direction. To go to the SI system, one shall take into account that for H: 1 GHS unit = 80 A/m

for E: 1 GHS unit = 30,000 B/m

Hence, the equation (9) takes the following form in the SI system:

$$3000E = 80H \tag{10}$$

or

$$E \approx 0.03H . \tag{11}$$

or

$$H \approx 30E \cdot \mathrm{tg}(\beta) . \tag{12}$$

An additional argument in favor of the existence of the electric field of the structure specified is the existence of the telluric currents [2]. There is no generally accepted explanation of their causes. On the basis of the foregoing, it shall be assumed that these currents must have the largest value in the direction of the parallels.

It is possible that the electric field of the Earth can be detected using a freely suspended electric dipole, made in the form of a long isolated rod with metal balls at the ends. It is also possible that oscillations of the rod will be recorded at the low frequency of changing in dipole charges.

Based on the hypothesis suggested, it can be assumed that the magnetic field shall be observed among planets with an atmosphere. Indeed, the Moon and Mars, free of the atmosphere, lack the magnetic field. However, there is no magnetic field at Venus. This may be due to the high density and conductivity of the atmosphere – it cannot be considered as an insulating layer of the spherical capacitor.

References

1. Khmelnik S.I. The Electromagnetic Wave in a Spherical Capacitor and the Nature of Earth Magnetism, Vixra Funding, http://vixra.org/funding, 2016-04-28, http://vixra.org/abs/1604.0371.
2. D.V. Sivukhin. The general course of physics. Volume 3. Electricity (in Russian).
3. Earth's magnetic field, Wikipedia (in Russian), https://ru.wikipedia.org/wiki/Магнитное_поле_Земли
4. Earth currents, Wikipedia (in Russian), https://ru.wikipedia.org/wiki/Земные_токи