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# ON INTERPRETATION OF THE MAGNETIC CHARGE EFFECT ON FERROMAGNETIC AEROSOLS

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# ON INTERPRETATION OF THE MAGNETIC CHARGE EFFECT ON FERROMAGNETIC AEROSOLS

V. F. Mikhailov

It has been shown that the magnitude of the magnetic charge observed at submicroparticles in a light beam can be equal or a multiple to the Dirac monopole charge $g_D = 3.29\cdot10^{-8}$ Gauss·cm$^2$.

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# О ИНТЕРПРЕТАЦИИ ЭФФЕКТА МАГНИТНОГО ЗАРЯДА НА АЭРОЗОЛЯХ ФЕРРОМАГНЕТИКОВ

В.Ф.Михайлов

Показано, что величина магнитного заряда, наблюдающегося на субмикронных микрочастицах в световом луче, может быть равна или кратна заряду монополя Дирака $g_D = 3{,}29\cdot10^{-8}$ Гс·см$^2$.

Библ. 6, илл. 2, стр. 10.

We reported in papers (Mikhailov 1983, 1985, 1987) that the particles of ferromagnetic aerosols possess magnetic charges under certain conditions. The attempt was made to estimate the magnitudes of the charges. The detailed description of the experiment was given in previous publications. So it has not repeat herein.

The determination of the magnetic charge magnitude has been carried out via the comparison of the forces acting on a particle, having both a magnetic (G) and an electrical (q) charges, in orthogonal, homogeneous, constant fields H and E (See Fig.1). In this case a force

$$\vec{F} = q\vec{E} + G\vec{H} + \frac{q}{c}(\vec{v}\times\vec{H}) + \frac{G}{c}(\vec{v}\times\vec{E}) \qquad (1)$$

acts upon a particle, where $\vec{v}$ is the particle velocity. In terms of projectios,

$$F_x = Kv_x = \frac{1}{c}(Gv_H E - qv_E H)$$
$$F_y = Kv_H = GH - \frac{G}{c}v_x E \qquad (2)$$
$$F_z = Kv_E = qE + \frac{q}{c}v_x H$$

where K is the Stockes coefficient.

Neglecting the terms that involve the factor $\frac{1}{c} = (\frac{1}{3})\, 10^{-10}$, we obtain the relation

$$G = q\,\frac{v_H E}{v_E H} \qquad (3)$$

On substituting the experimental values of $v_H$, $v_E$, E and H we have found that

[illegible] (4)

(Mikhailov 1985) where g is the elementary magnetic charge, $\alpha = 1/137$ is the fine structure constant, e is the electron charge, that is

$$g \sim \alpha^2 g_D \tag{5}$$

where $g_D = e / 2\alpha$ is the Dirac monopole charge.

## 2. NEW LOOK ON THE PROBLEM

D. Akers, when analysing our study, has paid our attention to the fact that if $v_x = 0$ in the set (2), another dependence is derived from the first equation:

$$G = q \frac{v_E H}{v_H E} \tag{6}$$

Experimental contents of this equality (according to the data published earlier (Mikhailov 1983)) results in the following magnitude of the charge:

$$G \sim g_D \tag{7}$$

Accuracy of the particle velocity measurements in this experiment does not prevalue several per cent. Thus, we have no reason for believing that $v_x = 0$. However, the experiment shows that $v_x \lesssim 10^{-2} v_H$ ($v_E$ and $v_H$ are the values of the same order). Due to this, we have made more correct analysis of the set (2) leading the following results.

From the first and the second equations of the set (2) we obtain

$$v_x^2 - v_x c\frac{H}{E} - \frac{q}{G} v_E v_H \frac{H}{E} + v_H^2 = 0 \tag{8}$$

whence

$$v_{x1,2} = \frac{cH}{2E} \pm \sqrt{\left(\frac{cH}{2E}\right)^2 + \frac{q}{G} v_E v_H \frac{H}{E} - v_H^2} \qquad (9)$$

From the first and the third equations

$$v_x^2 + v_x c \frac{E}{H} - \frac{G}{q} v_E v_H \frac{E}{H} + v_E^2 = 0, \qquad (10)$$

whence

$$v_{x3,4} = - \frac{cE}{2H} \pm \sqrt{\left(\frac{c \cdot E}{2H}\right)^2 + \frac{G}{q} v_E v_H \frac{E}{H} - v_E^2} \; . \qquad (11)$$

Introduce the following notations

$$\left. \begin{aligned} a &= \left(\frac{q}{G} v_E v_H \frac{H}{E} - v_H^2\right) \Big/ \left(\frac{cH}{2E}\right)^2 \\ b &= \left(\frac{G}{q} v_E v_H \frac{E}{H} - v_E^2\right) \Big/ \left(\frac{cE}{2H}\right)^2 \end{aligned} \right\} . \qquad (12)$$

Then

$$\left. \begin{aligned} v_{x1,2} &= \frac{cH}{2E} \left( 1 \pm \sqrt{1 + a} \right) \\ v_{x3,4} &= \frac{cE}{2H} \left( -1 \pm \sqrt{1 + b} \right) \end{aligned} \right\} , \qquad (13)$$

where $a \ll 1$, $b \ll 1$.

Expanding (13) into a series, we obtain, as the first approximation, the following expressions:

$$\left. \begin{aligned} v_{x1,2} &= \frac{cH}{2E} \left[ 1 \pm \left( 1 + \frac{1}{2} a \right) \right] \\ v_{x3,4} &= \frac{cE}{2H} \left[ -1 \pm \left( 1 + \frac{1}{2} b \right) \right] \end{aligned} \right\} . \qquad (14)$$

The signs before brackets should be chosen in such a way, that the units , when the brackets are open , are mutually concealed. In the opposite case $v_x \sim c$; however such particles are not observed in this experiment, for sure.

Then the equatios (14) acquire the form:

$$\left.\begin{aligned} v_{x2} &= -\frac{cH}{4E}\,a \\ v_{x3} &= \frac{cE}{4H}\,b \end{aligned}\right\} . \qquad (15)$$

A particle can not be described by two various magnitudes of a velocity at time instant. So, $v_{x2} \equiv v_{x3}$. Then from (15) we obtain the following equation with the eliminated velocity x - projection:

$$\frac{H}{E}\,a + \frac{E}{H}\,b = 0 \qquad (16)$$

After obvious transformations the equation for a magnetic charge is obtained from (16),

$$G^2 - Gq\left(\frac{Ev_H}{Hv_E} + \frac{Hv_E}{Ev_H}\right) + q^2 = 0, \qquad (17)$$

its solution at q = ne has the form:

$$G_{1,2} = ne\left[\frac{1}{2}\left(\frac{Ev_H}{Hv_E} + \frac{Hv_E}{Ev_H}\right) \pm \sqrt{\frac{1}{4}\left(\frac{Ev_H}{Hv_E} + \frac{Hv_E}{Ev_H}\right)^2 - 1}\,\right] \qquad (18)$$

where n is the number of elementary electrical charges e associated with the particle.

Basing on the formula (18), we have processed a series of new experiments, the latter being carried out following the technique used earlier (Mikhailov, 1983).

The magnetic charge magnitude has been determined individually for every particle. On the base of the obtained magnitudes of $G_1$ (a sign "+" before the radical in (18)) a histogram for charge distribution of particles has been constructed (See Fig.2). So far as the particle electrical charge is not defined, the application of (18) is connected with a certain arbitrariness of the n choice. Here the fact that the particle with a diameter less than $10^{-5}$ cm can keep only few elementary electrical charges (< 10) serves as the criterion of the choice. In the given case n has not exceeded 1 ÷ 4 for dominant number of particles.

The question is raised on the adequacy of (18) and the phenomenon physical sense.

The first root of (17), $G_1$, coincides with the magnitude of the Dirac monopole charge. Chance nature of the coincidence is hardly probable, as it is preserved under various regimes of operation of the experimental installation (for various ratios E/H, wavelengths and light radiation intensities).

On substituting the calculation results of (18) into (15), the magnitude of the velocity X-componemt, $v_x$, occurs less than $10^{-10}$ $cm \cdot s^{-1}$ for all observed particles. This fact does not contradict to a direct observation on chooses primarily neither root of (17). A numerical meaning of the charge, $G_2$, practically, coincides with the magnitude determined earlier (Mikhailov 1983). Besides, when measuring a magnetic charge by the static technique - a balance of a gravity force and a force acting on a particle in a homogeneous magnetic field (Ehrenhaft 1942, Ferber 1950, Schedling 1950) - the magnitudes within the interval $10^{-10} \div 10^{-14}$ Gauss·cm$^2$ have been received and that coincides with $G_2$. Thus, both meanings of a charge obtained by (18) have certain reasonings to be considered as objective ones, having physical sense.

Nevertheless, in this study we pay our attention to the first magnitude of a magnetic charge $G_1$, which surprisingly coincides with the monopole charge derived by Dirac theoretically.

## 3. CONCLUSION

We belive that the results of studies reported in this paper may be considered as the experimental argument in favour of reality of the Dirac magnetic monopole.

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REFERENCES

Ehrehaft F. (1942). Journal of the Franclin Institute, 233, 335.

Ferber J. A. (1950). Acta Physica Austriaca, 4, 133.

Mikhailov V. F. (1983). Physics Letters B, 130, 331.

Mikhailov V. F. (1985). Journal of Physics A, 18, L908.

Mikhailov V. F. (1987). Preprint of the Institute of High Energy Physics of Kazakh Sciences Academy, Alma-Ata, N87-14.

Schedling J. A. (1950). Acta Physica Austriaca, 4, 98.

FIGURE CAPTIONS

Fig. 1. Scheme of the fields of the experimental installation. Axis of a microscope coincides with axis OX. The plane of image is parallel to the plane YOZ.

Fig. 2. Distribution of the particle on magnetic charge. The complete number of particle in the series is $N = 681$; $E = 0.582$ CGSE ($174.6\ v \cdot cm^{-1}$), $H = 34.7$ Gauss, $\lambda = 4480$ Å.

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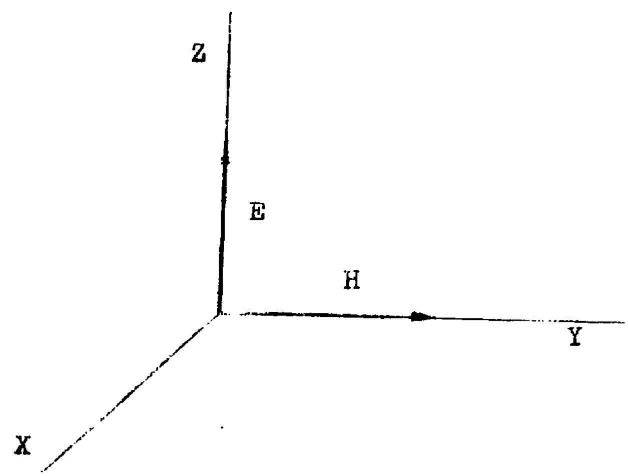
Z
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Рис.I.

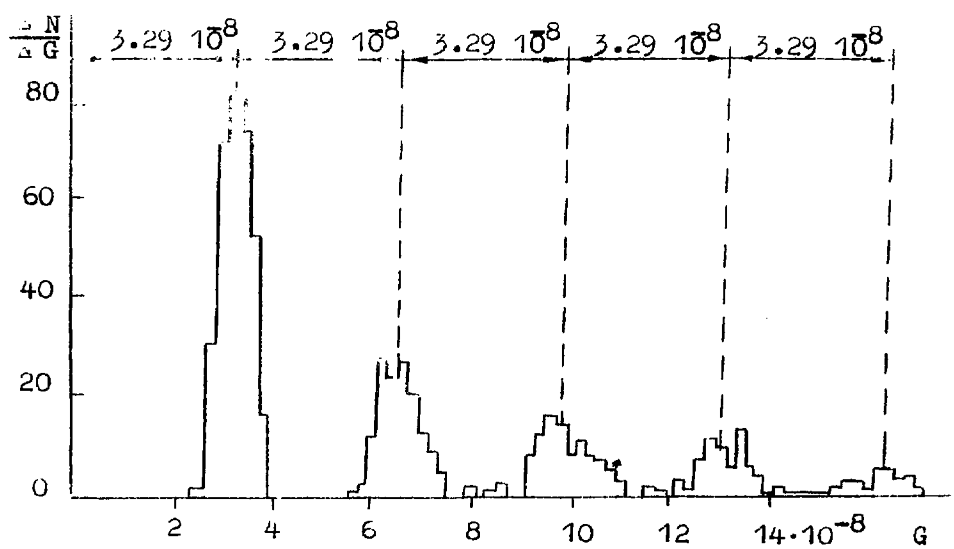
ΔN/ΔG
3.29 10⁻⁸
3.29 10⁻⁸
3.29 10⁻⁸
3.29 10⁻⁸
3.29 10⁻⁸
80
60
40
20
0
2
4
6
8
10
12
14·10⁻⁸
G

Рис.2.

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