Discovery and characterization of magnetic monopoles

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Discovery and characterization of magnetic monopoles

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Abstract: In 1931, Paul Dirac, a physicist of Britain, theoretically predicted that magnetic monopoles can exist independently, and believed that since electricity has electrons with basic charges, magnetism should also have magnetic monopoles with basic magnetic charges. Decades later, many scientists failed to find magnetic monopoles although they tried to do that in any way. Some outstanding physicists, such as Fermi, an Italian American physicist, and Yang Zhenning, a Chinese American physicist, believe that magnetic monopoles exist and have improved and supplemented Paul Dirac's theory.

In this paper, the author found a new crystal topological material that emits positive and negative magnetic monopole pairs (magnetic dipoles) and magnetic monopoles into space when excited by both alternating magnetic field and heat. A "string" predicted by Dirac exists when the magnetic dipole runs in space and extends and contracts under the action of external magnetic field, and separates into positive and negative magnetic monopoles at given magnetic field strength. Strong "γ" ray is released from annihilation which occurs when positive and negative magnetic monopoles collide with each other. The space speed, magnetic field intensity and magnetic monopole mass under different magnetic fields were measured and calculated. The catalytic fission of magnetic monopoles and the repulsion of antimagnetic materials were characterized. The existence of magnetic monopoles predicted by Dirac was proven by experiments and observations from different perspectives.

Key Word: magnetic monopole ; Catalytic Fission; Dirac Chord; Magnetic Charge; magnetic dipole; Magnetic Monopole annihilation

0. Introduction:

Since 1930s, magnetic monopole has been studied as a hot topic and sought by physicists and astronomers because the complex interaction process of magnetic monopole is very different from general electromagnetic phenomena we know at present. Magnetic monopoles are related to not only a source of material magnetism and the symmetry of electromagnetic phenomena, but also the evolution theory of the very early universe and the structure theory of micro particles.

In 1931, Paul Dirac, a Nobel Prize winner, extended the Maxwell's Equations to include magnetic monopoles. The Maxwell's equations are classical electromagnetic field theory, but this theory fails to perfectly explain why magnetic monopoles cannot be found and why charges exist with a fixed value. When Maxwell's equations are extended to include magnetic monopoles, charges can exist only with a fixed value[1], unifying the classical electromagnetic field theory and quantum electrodynamics. Also, Enrico Fermi, a famous Italian American physicist, has theoretically discussed the magnetic monopole and believes that its existence is possible. Yang Zhenning, a Chinese American physicist, and other famous scientists have supplemented and improved the magnetic monopole theory from different aspects to some different extents, eliminated some defects in Dirac theory, and provided a more powerful theoretical basis for the assumption of the existence of magnetic monopoles.

In 2013, the author successfully researched and developed a new topological material. When the new topological material was excited to emit and accept terahertz magnetic waves, i.e. it was used as a terahertz wave emitter while as a accepting sensor, it was found that the terahertz magnetic wave accepting sensor was seriously interfered irregularly, even when the terahertz magnetic wave was blocked with an iron plate. In view of the abnormal phenomena, it is found during more than seven years' experiments of cloud chamber, photography, air ionization and catalytic fission of protons that the new topological material emits magnetic monopole and dipole into the space and the magnetic monopole is successfully captured by an aluminum plate.

The discovery of magnetic monopole will greatly promote the exploration of the universe and the theory of electromagnetism. It is very significant and influential in the development of basic physical theories[2,3], even in science and philosophy, and will greatly change the development of practical technologies.

1. Basic Characteristics of New Topological Material and Conditions to Produce

Magnetic Monopoles

1.1 Basic Characteristics of New Topological Material

The new topological material is a catalytically synthesized semi metallic topological material with medium impedance. The material itself is spontaneously magnetized internally without reliance on the external strong magnetic field under the action of an electric field[4,5]. The differences between abnormal Hall effect reflected by the material and the long-range ferromagnetic order reflected by the abnormal Hall effect of quantum lie in different current direction and thus different direction of magnetic field during magnetization of distribution points in each region because only two local connecting points between a small region composed of magnetic domains formed in the material and other regions can conduct electricity and other surfaces are insulated and isolated resulting in the formation of a complex network structure in the material. In this paper, the existence of magnetic monopole was proven by characterizing the magnetic monopole, so the structure of its material was not described further.

1.2. Conditions to Produce Magnetic Monopoles

The new topological material is excited to emit magnetic dipole and monopole in two modes. In Mode A, the material is internally magnetized to form a ground state magnetic dipole under the action of DC electric field; then the ground state magnetic dipole jumps to the excited state under the action of external heat energy; the excited state magnetic dipole is excited to escape and emit into space when an alternating magnetic field is applied. The small magnetized area on the surface of the material is excited to emit magnetic dipoles. However, the small magnetized area in the middle of the material is excited to emit magnetic dipoles which pass through the thickness of the material and are separated into positive and negative magnetic monopoles in contact with strong magnetic field in the strong magnetized area. Therefore, the particles emitted into the space are a mix of magnetic dipoles and monopoles. In Mode B, the material is heated to the emission temperature by an alternating electromagnetic field, where the positive or negative half cycle magnetizes the material and directly transfers the magnetized ground state magnetic dipole to the excited state, so the magnetic dipole is excited to emit into the space when the reverse magnetic field intensity in the adjacent region gradually becomes big enough to excite the excited state magnetic dipole. Due to the differences in magnetic field intensity, position in the material and emission angle during excitation, the initial velocity of magnetic dipole or monopole is different, which can be explained through characterization and observation of magnetic monopole.

2. Characterization and Observation of Magnetic Monopole

The observation and analysis of magnetic dipole and monopole by cloud chamber and photography show that the various characteristics of magnetic monopole are consistent with those predicted by Paul Dirac [6,7]. It is also found that the magnetic monopole characterization results not involved in Paul Dirac's prediction are consistent with those predicted by grand unified theories.

2.1 Observation by Cloud Chamber

The tracks of magnetic monopole and dipole separated by magnetic field were observed through cloud chamber.

The self-made cloud chamber has the dimension of 35 cm x 8 cm x 8 cm. It has five faces available in 5 mm thick plastic plate and one face available in 3 mm thick glass plate for observation. A brownish black observation plates was added opposite the glass plate. Ethanol was added into the cloud chamber till saturation. The At temp chamber was controlled at 25~30 ℃ . Ice or dry ice was placed under the cloud chamber. The new topological material (Hereinafter referred to as exciting material) was placed 10 cm away from one side of the cloud chamber and excited in Mode B.

Fig. 1 a. is a cloud chamber diagram (most parts) showing that white straight tracks are formed by the semi permanent scratches left by the magnetic monopole in the middle of the glass plate of cloud chamber after the exciting material works for 5 minutes without external magnetic field. The magnetic dipoles at low velocity cannot pass through the plastic plates, but only the magnetic dipoles and monopoles running at high velocity can pass through the plastic plates, so it is assumed that the magnetic monopoles passing through the plastic plates run at medium velocity. Magnetic monopoles cannot pass through the glass plates (See 2.5.1). To make observation on the glass plates, an angle between the exciting material and the glass plate of the cloud chamber must be kept so that the magnetic monopoles or magnetic dipoles passing through the plastic plate can impact the glass plate and slide for a period of time to form white tracks.

Fig. 1b is a partial view of Fig. 1a.

Fig. 1c shows that a 0.1T magnet with the dimension of 35 mm x 35 mm x 8 mm is added to the top of the end of the cloud chamber; the running tracks of the magnetic monopoles are bent under the action of the magnetic field force, and white tracks appear at the end of the glass of the cloud chamber.

Fig. 1d is a partial view of Fig. 1c.

Fig. 1e shows that the magnetic dipoles passing through the plastic plates are separated into positive and negative magnetic monopoles under the action of magnetic field applied at the end of the cloud chamber in Fig. 1c before some positive magnetic monopoles deflect upward and some negative magnetic monopoles deflect downward.

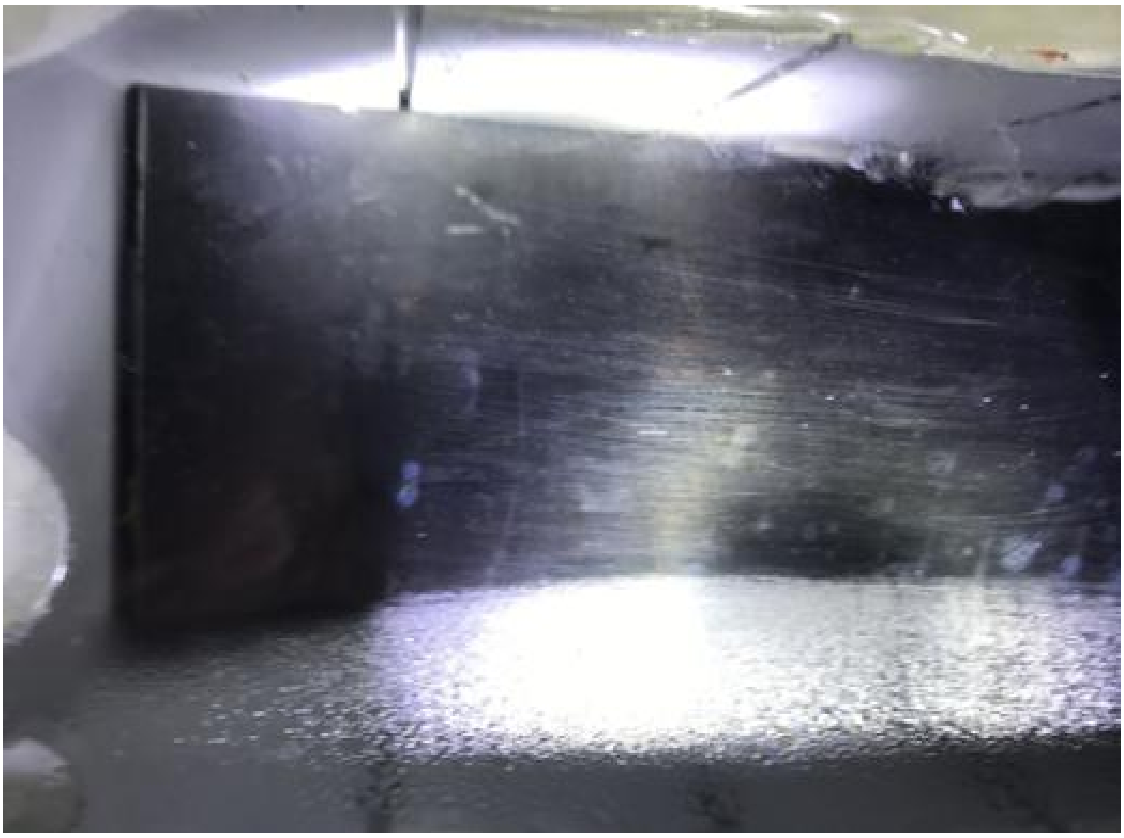


Fig. 1a White Tracks Left by the Magnetic Monopoles in the Middle of the Glass of the Cloud Chamber

40mm x 80mm

Fig. 1b Partial View of Fig. 1a

Fig. 1c White Tracks Left by the Magnetic Monopole on the Glass at the End of the Cloud Chamber Due to the External Magnetic Field.

35mm x 60mm

Fig. 1d Partial View of Fig. 1c

(Note: The large white stain on the glass is a very thin film of cured epoxy resin to bind the glass and thus never affects the observation.)

35mm x 55mm

Fig. 1e Partial View of Magnetic Dipoles Separated into Positive and Negative

Magnetic Monopoles by the External Magnetic field

2.2 Observation by Photography

2.2.1 The magnetic dipoles running at low velocity are separated into positive and negative magnetic monopoles under the action of a magnetic field.

Fig. 2 shows the tracks left by the magnetic dipoles separated into positive and negative magnetic monopoles which ionize air to produce weak light at the applied magnetic field intensity of 2 mT and the distance of 5 cm between magnetic dipoles running at low velocity. The separation of magnetic dipoles in the photo shows that that there is a "string" predicted by Paul Dirac when the magnetic dipoles are running in space; the positive and negative magnetic monopoles are bound together under the action of "string" and separated from each other at a certain magnetic field intensity under the action of external magnetic field force.

62mm x 100mm

Fig. 2 Separation Of Magnetic Dipoles Running At Low Velocity Under The Action Of Magnetic Field

2.2.2 The running tracks of low-velocity magnetic dipoles are bent under the action of electrostatic field.

Fig. 3 shows that when the magnetic dipoles composed of positive and negative magnetic monopoles run at low velocity in space, the running track is slightly bent under the action of electrostatic field force. The distance between the positive and negative magnetic dipoles does not change because the electrostatic field only repulses the magnetic dipoles.

2580nm x 1940nm

Fig. 3 Bent tracks of magnetic dipoles under the action of electrostatic force.

2.2.3 The "string" of magnetic dipole running at low velocity extends and contracts under the action of geomagnetic field.

Fig. 4 shows the transparent traces left after development of the photographic film, which is impacted by magnetic dipoles leading to proton fission of the material. Magnetic dipoles are excited to emit into the space at different angles and velocities, leading to different influences of geomagnetism and different change of the distance between positive and negative magnetic monopoles in the magnetic dipole. Thus, that proves that a "string" predicted by Paul Dirac exists between the positive and negative magnetic monopoles in the magnetic dipole and extends and contracts due to the change of the external magnetic field intensity when the magnetic field intensity is too small to separate positive and negative magnetic monopoles. However, this "string" is only a "string" predicted in theory. In fact, the existence of "string" can indirectly proved only by magnetic field force and different distances between positive and negative magnetic monopoles and can’t be directly observed, consistent with Paul Dirac’s theory of "string".

2580nm x 1940nm

Fig.4 Extension and contraction of Paul Dirac "string" of magnetic dipole under the action of geomagnetic field.

2.3 Annihilation of Magnetic Monopole

A magnetic monopole annihilator shown in Fig.5a was manufactured by placing the exciting materials on both sides of the insulation plate with the length of 60 cm and width of 40 cm first and then placing a magnet with the S-pole surface upward and a magnet the N-pole surface upward at 5 cm from the exciting materials on both sides, respectively. Two lead plates with the dimension of 10 cm x 20 cm x 20 cm were externally surrounded by glass. A γ -ray detector was installed between the two lead plates. An iron box was placed between two exciting materials and externally insulated. The iron box has the dimension of 4 cm x 4cm x 4 cm and holds a built-in temperature sensor. The thickness of the exciting materials should not exceed 0.5 mm so that high-velocity magnetic monopole couldn’t pass through the glass. The magnetic monopole annihilator works in such a principle that when the materials on both sides emit magnetic dipoles or magnetic monopoles, the magnetic dipoles are separated into positive and negative magnetic monopoles, which are deflected, under the action of the external magnetic field; the running tracks of magnetic monopoles with one side positively polar and the other side negatively polar are bent and accelerated, forcing the positive and negative magnetic monopoles to collide inside the iron box (and outside the box) due to the opposite polar magnetic fields of the magnets on both sides. The glass which externally surrounding the lead plates blocks the medium velocity magnetic monopoles and prevents the fission during the impact on the lead plates leading to inaccurate detection. The lead plates can avoid the formation of γ ray from the fission of the impacted metal particles in the exciting material leading to inaccurate detection.

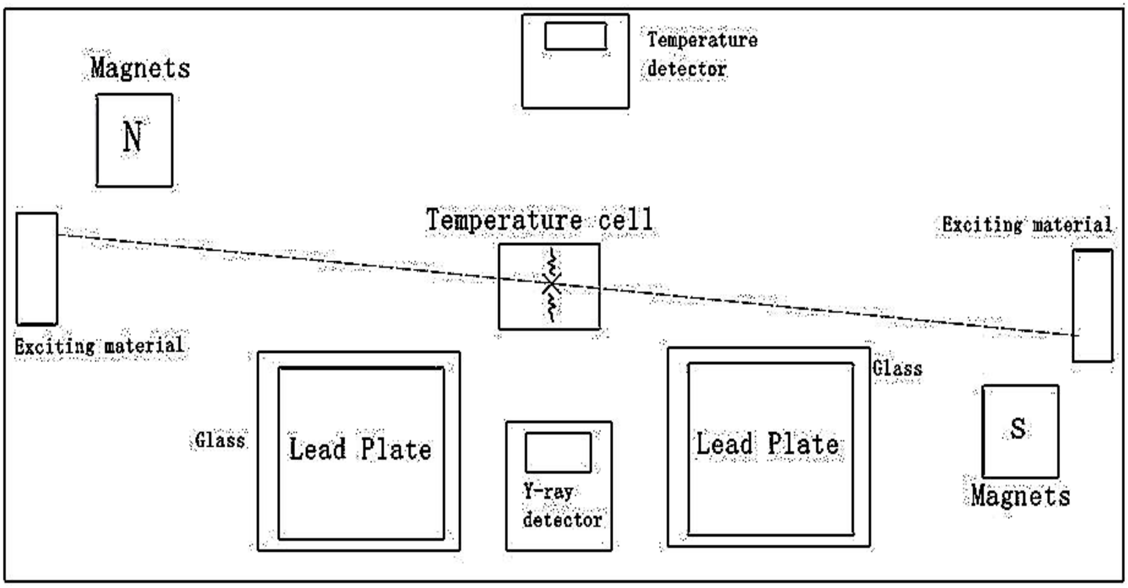


Fig. 5a Schematic Diagram of Magnetic Monopole Annihilator

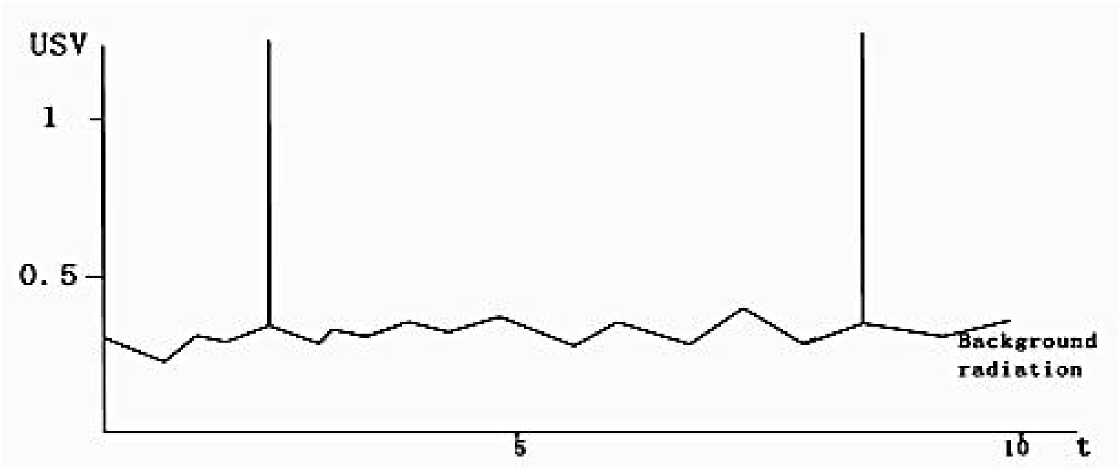
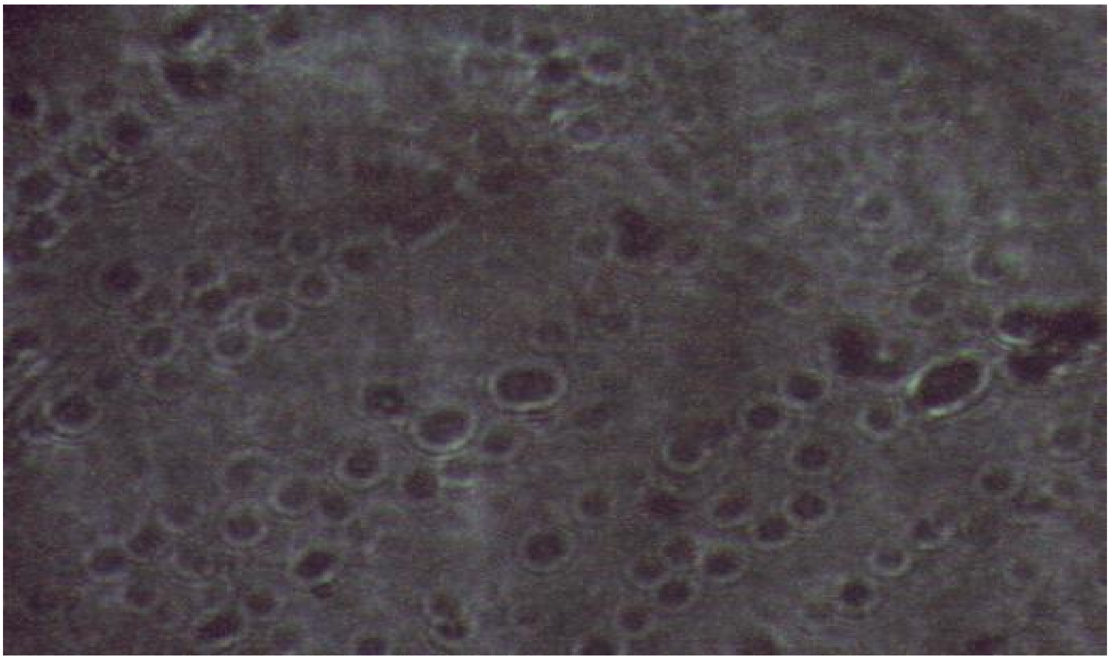


Fig. 5b Realtime Diagram of mean value of "γ" ray test results under background radiation

Fig. 5b shows the mean value of test results under background radiation. It is difficult to identify the γ ray intensity from the real-time diagram because the equipment has the maximum resolution of 1.2 USV/h. The γ ray ionizes and heats the air in the detection box during annihilation. It is accordingly found that the air temperature in the iron box rises by about 0. 1℃ when each pair of positive and negative magnetic monopoles annihilates. The repeated detection and comparison show that all the "γ" rays produced from annihilation of pairs of positive and negative magnetic monopoles have the constant intensity, proving that the “γ” rays produced from annihilation have high intensity. No γ ray was detected at elevated temperature, showing that the positive and negative magnetic monopoles spin, which is related to the collision angle during annihilation, and the emission angle of “γ” rays changes.

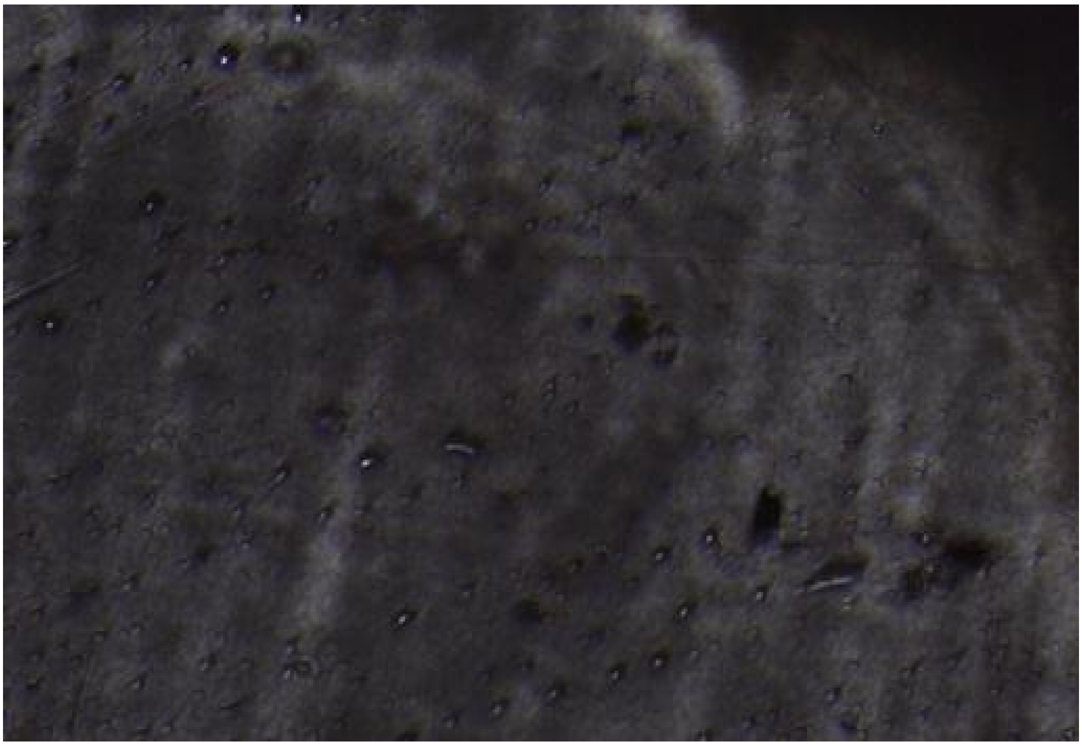
2.4 Magnetic Monopole Catalyzed Proton Fission

Magnetic monopole can catalyze proton fission [8]. Fig. 6a shows the traces like meteorite craters left when the photographic film is deformed by the heat from catalytic fission of the protons of the film material when the magnetic monopole impacts the film. Fig. 6b shows the locally thermally deformed protruding points left when the magnetic monopoles pass through the film, viewed from the back of the film. Fig. 6c is a film impacted by the magnetic dipoles and monopoles, exposed and developed. It can be seen from the film that transparent holes are left by the material falling off the impact point of the film after magnetic dipoles and monopoles impact the film to cause fission. The above observations prove that the magnetic monopoles or magnetic dipoles impact the material the proton to leading to proton fission and release of a large amount of heat.



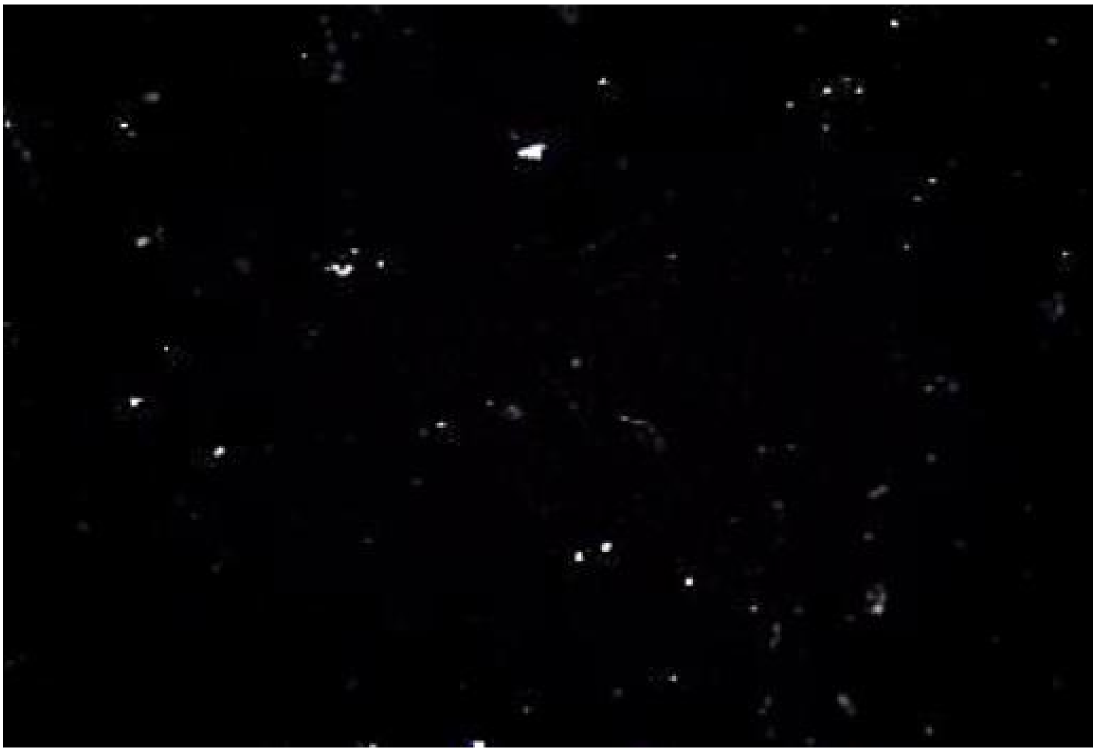
2400nm x 1900nm

Fig. 6a Traces like meteorite craters left from magnetic monopole catalyzed fission



2400nm x 1900nm

Fig. 6b Locally deformed protruding points left after the magnetic monopoles passes through the back of the film



2400nm x 1900nm

Fig. 6c Transparent holes left by the fission of film material by magnetic monopoles

2.5 Other

2.5.1 Low and medium velocity magnetic monopoles and dipoles cannot pass through the glass.

It is experimentally proved that low and medium velocity magnetic monopoles cannot pass through the glass. An electronic balance (accurate to 0.1 mg) was used for weighing experiment. A 0.5 mm-thick exciting material with the effective area of 3.5 cm x 4.5 cm was placed on the quartz plate with the dimension of 5 cm x 5 cm x 1.5 mm, with ϕ0.1mm enamelled wire as a lead wire. The material was excited in Mode B.

(1) The material covered the glass in the balance tray. The balance was enclosed by 3 mm glass. The weighing experiment is as follows: (the exciting material content of 10%)

Decrease of weight under applied power   Immediate decrease of weight after removal of the top glass

7.0021g ⟶ 6.9603g ⟶ 6.9396g

Weight under no power

(2) The material faces upwards on the glass in the balance tray. The weighing experiment is as follows:

(The weight is different from the above due to the lead wire, but it does not affect the test data.)

Increase of weight under applied power   Immediate decrease of weight after removal of the top glass

6.8193g ⟶ 6.8346g ⟶ 6.8120g

Weight under no power

In Experiment (1), the emission surface of the exciting material covers the glass, so the repulsion between the emitted magnetic monopoles or dipoles and the glass in the balance tray causes the suspension force of the experimental plate and further a decrease of weight. In Experiment (2), the emission surface is upward, so the reflection of the top glass of the balance causes an increase of the weight of the experimental plate. In Experiments (1) and (2), the weight reduces after removal of the top glass from the balance, proving that the low and medium magnetic monopoles or dipoles produce reflection force because they cannot pass through the top glass of the balance.

2.5.2 Magnetic monopoles strongly repulse magnetic substances.

Magnetic monopoles running in space strongly repulse magnetic substances. Fig. 7a shows the repulsion produced when low-velocity magnetic monopoles running on the photographic film contact the black paperboard wrapped on the film surface. Fig. 7b is an enlarged view of the rebound of low-velocity magnetic monopoles contacting the paperboard. (When the magnetic monopoles are running at low velocity, air produces weak ionization light, to which the film is exposed.)

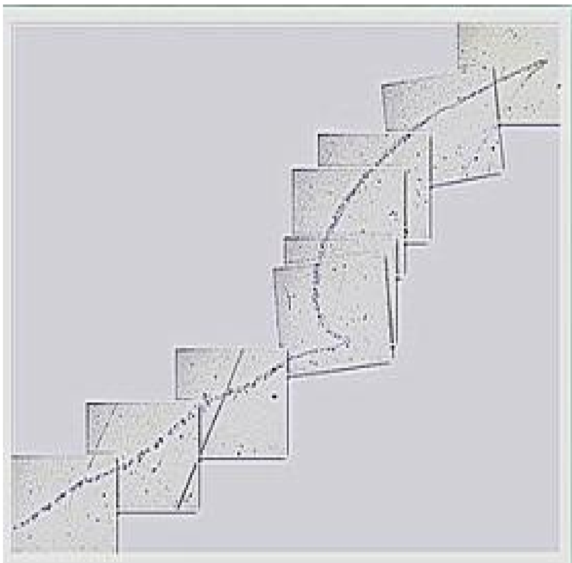


Fig. 7a Repulsion between Magnetic Monopoles and Diamagnetic Substances (Merged image)

2580nm x 1940nm

Fig. 7b Enlarged View of the Top

3. Detection and Calculation

3.**1 Calculation of the Track Radius of Magnetic Monopoles**

According to the tracks left by the magnetic monopoles on the glass in Fig. 1d or Fig. 1e, a running track of the magnetic monopoles is found as the track curve for calculation of the radius, as shown in Fig. 8.

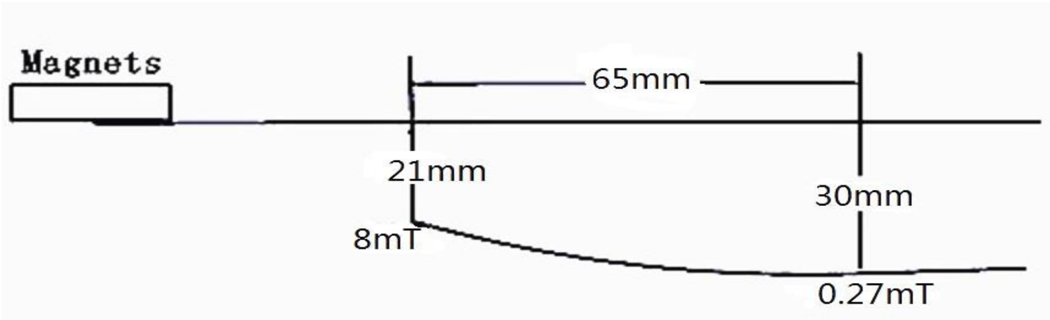


Fig. 8 Track Bending Diagram of Magnetic Monopole under the Action of Magnetic Field

The arc length is calculated according to the Pythagorean theorem and the known conditions in the diagram, and then the radius of the track of the magnetic monopoles passing through the plastic plate is calculated according to the formula $R = \frac{L^2}{(8h)} + \frac{h}{2}$. The calculated **R is 0.586 m**.

3.2 Detection of Magnetic Field Intensity

3.2.1 Low-velocity magnetic monopoles can pass through metals such as iron. Thus, a small magnetic shielding chamber was made of 3 cm thick steel plate. The magnetic field intensity in the magnetic shielding chamber was detected by WT-10 magnetic field tester when the low-velocity magnetic monopoles entered the chamber. The detected magnetic field intensity is $3.6\times10^{-7}\mathrm{T}$.

3.2.2 As shown in Fig. 9, an aluminum plate with the dimension of 30 x 20 x 5 mm captures magnetic monopoles, which are N poles. The average of the sum of the data detected on the front and back sides is 56 captured magnetic monopoles, and the calculated magnetic field intensity of a single magnetic monopole is $3.6\times10^{-7}\mathrm{T}$. (The storage time of magnetic monopoles in aluminum is related to temperature, i.e. the lower the temperature is, the longer the storage time is. For example, the storage time is about 5 h at 25 ℃.)

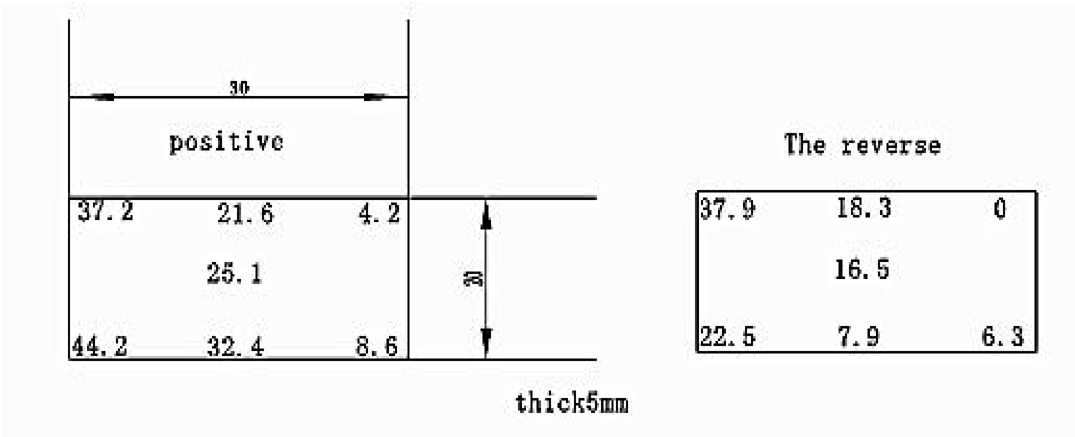


Fig. 9 Schematic Diagram of Aluminum Captured Magnetic Monopoles

3.3 Detection and Velocity Calculation

The running velocity of the magnetic monopole after passing through the plastic plate was calculated according to the voltage generated by the magnetic monopole passing through a coil [9]. In the test, the magnetic monopole passed through the plastic plate first and then through 7500-turn hollow copper coil, which was blocked by the glass to avoid the impact of the magnetic monopole catalyzed copper fission on the detection data. The center was reserved so that the magnetic monopole could pass through it. The voltage generated when each magnetic monopole passed through the coil was measured to be $1.2\times10^{-7}V$ by ADCMT-7641 precision voltmeter made by Japan. The dimensions of the coils are shown in Fig. 10.

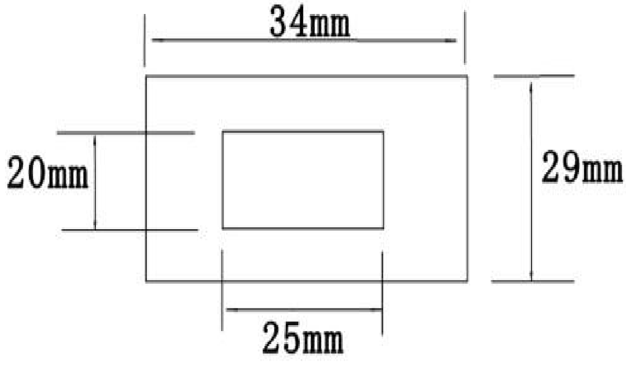


Fig. 10 Hollow Copper Coil

Because the magnetic monopoles have consistent magnetic lines of force in all directions, the voltage E generated when the coil cuts the magnetic line of force is related to the $\frac{1}{R^3}$ attenuation of the distance radius R of the magnetic monopole from the coil. The radius of the magnetic monopoles is neglectable.

Then the electromotive force generated by cutting the magnetic line of force is calculated according to $E=NBSV$, where N is the number of coil turns, B is the magnetic field intensity, S is effective cross-sectional area, and V is velocity. Formula (1) is given as follows:

$$(1) \qquad V = \frac{E}{NBSR^3} = 33774.3m/s$$

According to Formula (1) and known conditions, the velocity of the magnetic monopole after passing through the plastic plate is calculated to be **33774.3m/s.**

3.4 Calculation of Magnetic Monopole Mass

The law of interaction laws of electric field and magnetic field in vacuum proposed by Mr. Coulomb in 1787 are as follows:

$$(2) \qquad F_0 = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{T_{12}{}^2} r_{12}^0$$

$$(3) \qquad F_m = \frac{1}{4\pi\mu_0}\frac{\phi_1\phi_2}{T_{12}^2} r_{12}^0$$

For the interaction force between any pair of particles carrying a basic charge e and having the distance r in Formula (2) and for the interaction force between any pair of particles carrying a basic magnetic charge ϕ and having the distance r in Formula (3), Formula (4) can be obtained according to Formulas (2) and (3) if the two charges have the same distance r from two magnetic charges [10,11]. The force ratio of two charges to two magnetic charges is calculated according to Formula (4) below:

$$(4) \qquad \frac{F_0}{Fm} = \frac{\mu_0 a^2}{\varepsilon_0 \phi_0} \approx \frac{1}{1174}$$

In Formula (4), the force between magnetic monopoles is about 1174 times that between electrons.

The mass M of the magnetic monopoles is calculated according to the known velocity V of magnetic monopoles, magnetic field intensity B2 and radius R under the action of magnetic field B1.

Refer to the calculation formula of electron mass M:

$$(5) \qquad M = \frac{B_1 QR}{V}$$

The deflection electron Q accelerated by the force between electron and magnetic field is calculated according to Formula (5) [12]. A magnetic field can bend and accelerate the running track of the magnetic monopoles. Thus, if the electronic electric field intensity Q in Formula (5) is changed to the magnetic field intensity B2, the force applied by the magnetic field to the magnetic monopoles is 1/2 (1174) higher than that to the electrons. If the ratio of the force between magnetic monopoles to the force between electrons of 1174 is taken as the K value, the following formula can be obtained:

Where B1 is the average magnetic field intensity obtained from the curve in Fig. 8.

$$\mathrm{M} = \frac{1}{2}\mathrm{K}\frac{\mathrm{B_1B_2R}}{\mathrm{V}} \approx 1.516\times 10^{-11}\mathrm{Kg}(15.16ng) \qquad (6)$$

According to Formula (6) and known conditions, the mass of the magnetic monopoles is calculated to be $\mathrm{M} = 1.516\times 10^{-11}\mathrm{Kg}$.

4. Conclusion

(1) According to **t**he observations of cloud chamber and photos and other characterization, the five basic characteristics of magnetic monopole predicted by Paul Dirac [16] were proven and the existence of magnetic monopole was confirmed. It is found that the "string" (invisible) predicted by Paul Dirac can extend and contract with the change of external magnetic field just like a spring. With increasing velocity of the magnetic dipole, the kinetic energy increases. Bigger velocity leads to stronger "string" force of the positive and negative magnetic monopoles, closer combination between them, and stronger external magnetic field force for separation or extension and contraction.

(2) Confirmation of Paul Dirac's quantization conditions [13,14].

$$(1) \qquad eg = \frac{n\varepsilon_0 \mathrm{h}c}{2} \qquad\qquad g = ng_D$$

$$(2) \qquad g_D = \frac{\varepsilon_0 \mathrm{hc}}{2e} = 68.5e$$

Formulas (1) and (2) are Paul Dirac's quantization conditions. In Formula (1), g is the magnetic charge, e is the elementary charge, n is a constant, and H is the reduced Planck quantum constant, ε_0 is the vacuum dielectric constant, c is the velocity of light. In Formula (2), g_D is the unit Paul Dirac magnetic charge. According to the known data and Formulas (1) and (2), the unit Paul Dirac magnetic charge is calculated to be about 68.3e, basically consistent with the unit magnetic charge predicted by Dirac.

(3) The vacuum spontaneous breaking mechanism in the grand unified theories predicts that magnetic monopole should exist [15,16] and its magnetic charge and mass should comply with Paul Dirac's quantization conditions, i.e.

$$\mathrm{m} = \frac{g\varepsilon}{c^2(he)^{1/2}} \approx \frac{10^{16}GeV}{c^2} \quad (3)$$

Where ε is the energy scale of the grand unified theories.

The measured and calculated values of magnetic monopole mass are converted into electron volts, i.e. $8.5275\times10^{15}\mathrm{G}\ eV$ / c^2 , which is basically close to the mass predicted by the grand unified theories.

(4) All photos and test data provided in this paper are experimentally repeatable. If you have any doubts, the author can carry out various field experiments.

Acknowledgment:

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