the general science journal

The origin of magnetic fields,

Faraday's, Barnett's, Rowland's

and Einstein-de-Haas' effects

Jean de Climont, Paris

E-mail : jeandeclimont@yahoo.ca

Abstract

Abstract

Maxwell's equations attribute magnetic fields to the translation of electrons, both in conductors and in electron beams. However, electrons have an intrinsic magnetic field. It follows that in conductors as in electron beams there are simultaneously two potential causes of the magnetic field.

The absence of a magnetic field from electron beams at the exit of cyclotrons allows us to affirm that the one and only cause of these fields is the intrinsic magnetic field of the electrons.

Résumé

Les équations de Maxwell attribuent les champs magnétiques à la translation des électrons, aussi bien dans les conducteurs que dans les. Or, les électrons ont un champ magnétique intrinsèque. Il en résulte que dans les conducteurs comme dans les faisceaux d'électrons il existe simultanément deux causes potentielles du champ magnétique.

L'absence de champ magnétique des faisceaux d'électrons à la sortie des cyclotrons permet d'affirmer que la seule et unique cause de ces champs est le champ magnétique intrinsèque des électrons.

1. Introduction

The Danish physicist Christian Ørsted rediscovered the effect of electric current on magnets in 1820.

This effect had been discovered by Domenico Romagnosi as early as 1802.

A compass needle is deflected by an electric current.

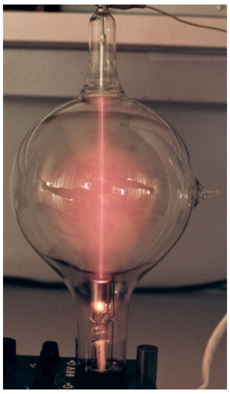
In 1875, Henry Rowland discovered that an electrically charged disk set in rotation has a magnetic field.

These two experiments seem to show that the magnetic field results from the translation of electrons. Is this correct?

It has been deduced that the intrinsic magnetic field of electrons would result from the rotation of the electron charge which would therefore have a dipole structure, although there is no experimental evidence. Is this correct?

Climont's experiment is intended to show that this is not the case in both cases!

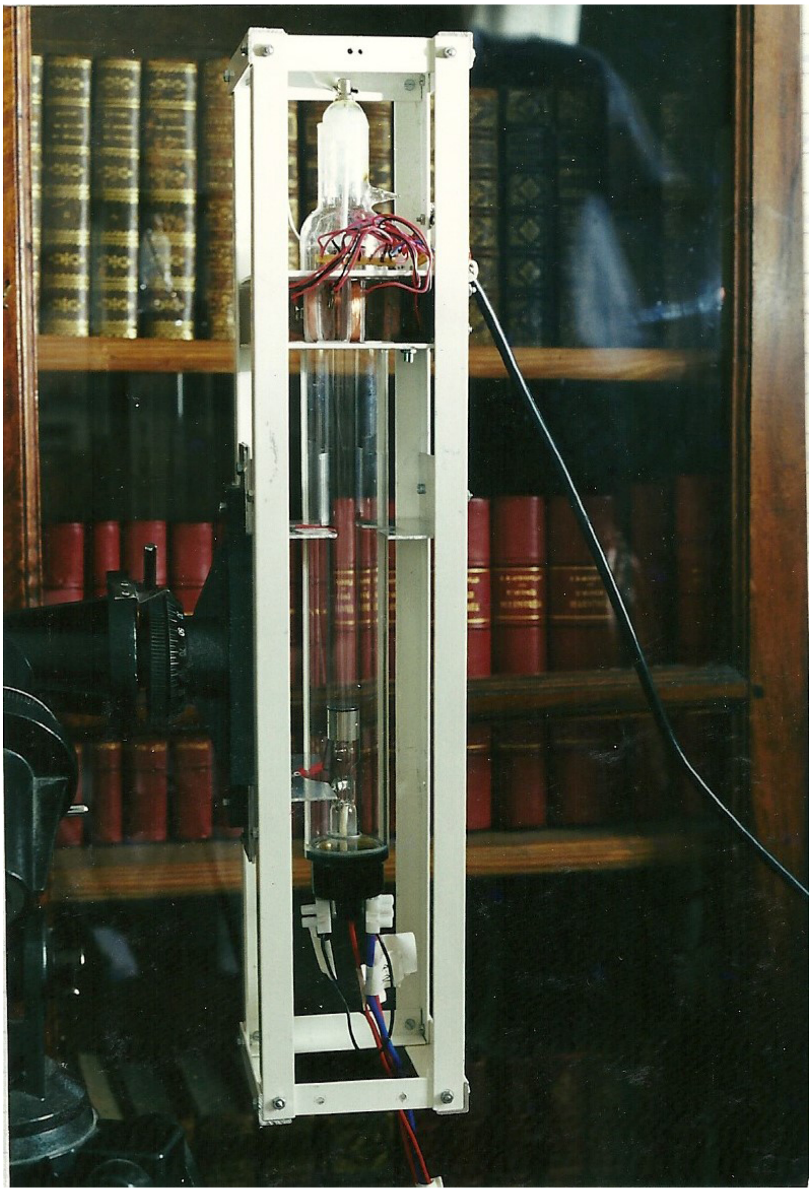
2 The cathode rays

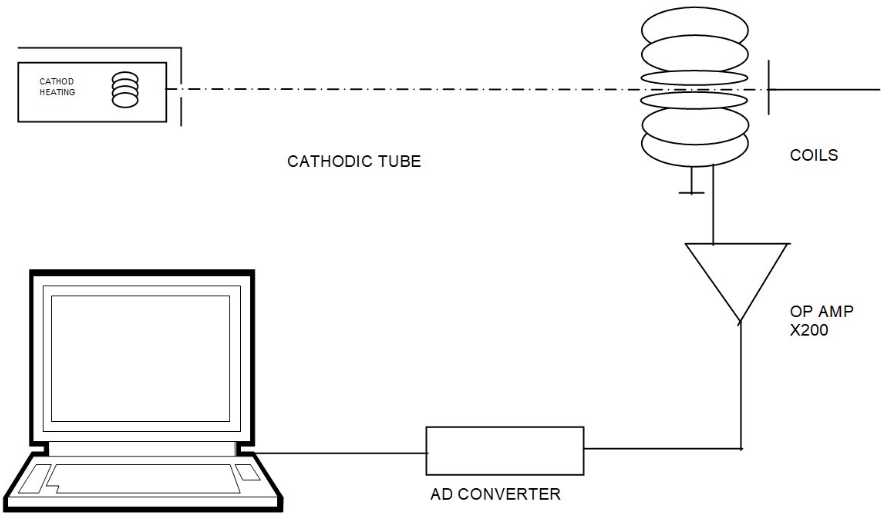


Cathode rays have a magnetic field. It is demonstrated with an electron gun from a NARVA PR2 tube made of ordinary glass inserted and glued into a 42 mm diameter borosilicate tube. The tube was placed under vacuum. The degassing of the glue only allows the tube to be used for a few dozen of minutes.

A target placed at the other end of the tube allows to measure an intensity of the electron beam of about 0.5 milli-Amps.

The magnetic field of the cathode ray is less than 10E-8 Tesla, the only usable means is the induction coil. The sensor consists of 12 coils of about 1400 turns each.



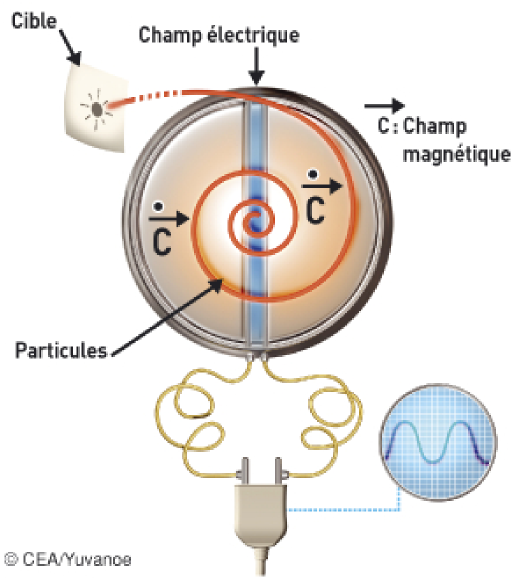

CATHOD
HEATING
CATHODIC TUBE
COILS
OP AMP
X200
AD CONVERTER

The anode of the electron gun was supplied with 350 VAC 50 Hz rectified but not filtered. This results in a 100 Hertz pulsation of the intensity of the cathode ray and therefore of its magnetic field.

This pulsation of the magnetic field of the cathode ray induces a voltage of 17 millivolts in the sensor after amplification.

Cathode rays do have a magnetic field.

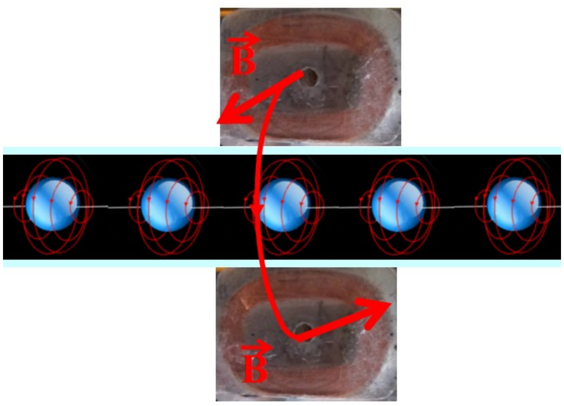
3 The Cyclotron



However, scientists have known for a long time that electron, proton or ion beams at the exit of cyclotrons do not have a magnetic field although these particles move at speeds of several tens of thousands of kilometers per second.

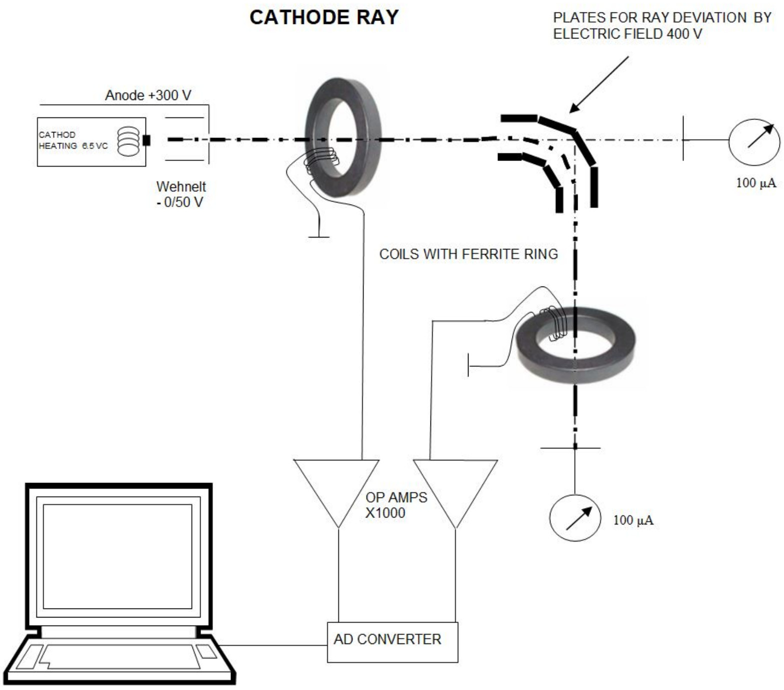
They attribute this cancellation of the field to a field resulting from the electric charge of the tube at the exit of the cyclotron. One may wonder how this field is informed of the amplitude of the magnetic field of the beam in order to be able to cancel it. There is, however, a more rational explanation.

The magnetic field of the beams and therefore of the electric currents does not come from the movement of the electrons. It comes from the intrinsic magnetic moment of the electrons. Now this intrinsic magnetic field of the electrons was measured by the coils of the cathode ray tube. The coils are therefore crossed by field lines which necessarily have a rotational structure.



Their intrinsic magnetic fields are aligned in the direction given by the gun, but as they then rotate in the cyclotron, the beam no longer has a magnetic field.
The aim of Climont's experiment is to confirm this phenomenon.

4 Curved cathode ray tube

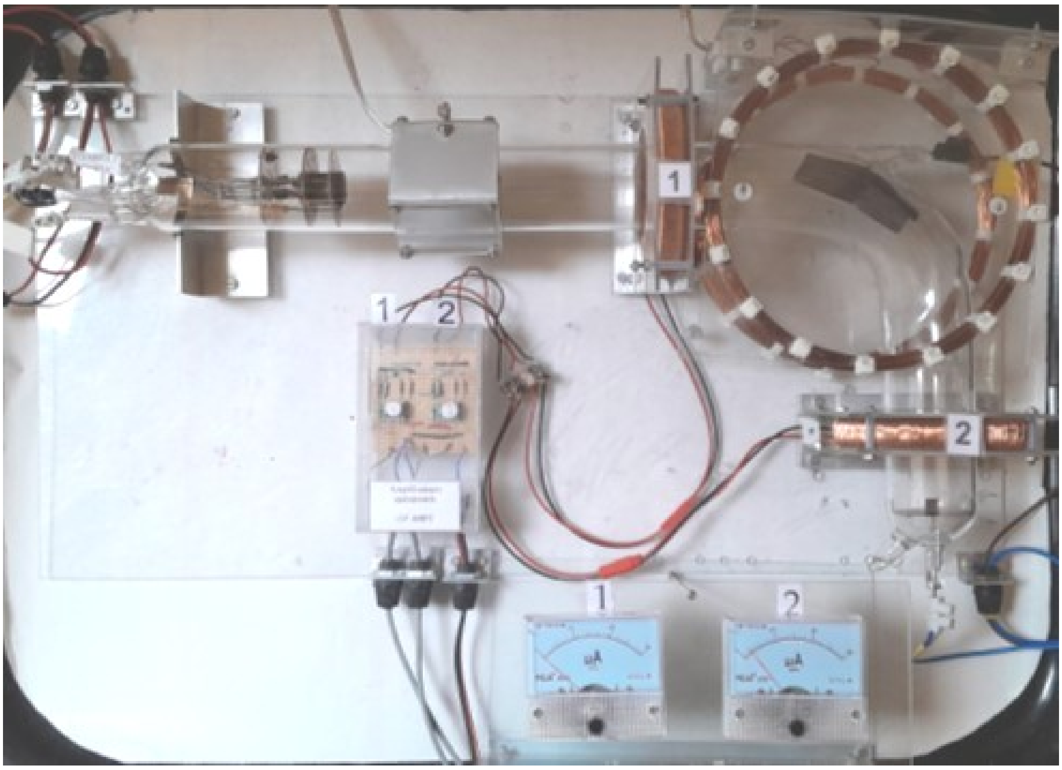


The electron gun is now inserted into a borosilicate tube that is bent at 90° in its middle part. Two targets have been placed in the tube. These targets are connected to milliamp meters, intended to check the presence of the cathode ray before and after the bend.

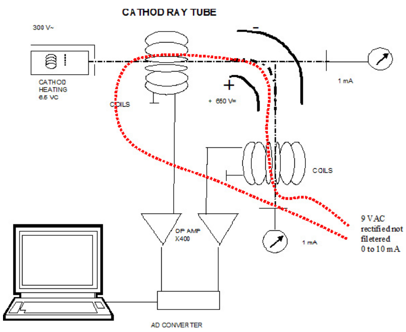
The anode of the electron gun is also supplied with 350 VAC 50Hz rectified but not filtered. This also results in a 100 Hertz pulse of the intensity of the cathode ray.

This pulse induces a voltage in the sensors. The first sensor is the one for measuring the magnetic field of the beam. The second sensor is practically identical to the first with 17,530 turns compared to 17,050 for the first sensor. These sensors were subsequently replaced by a winding of 1000 turns on ferrite rings.

The sensor signals are sent to two AD 820 integrated linear amplifiers. The gain is 400. The offsets are not corrected. The amplified signals are sent to an analog-digital converter connected to a USB port of a computer equipped with a digital oscilloscope.



5 Calibration



In order to calibrate the measuring device an electric wire is passed through the two sensors.

It is supplied with 9 volts rectified unfiltered and a potentiometer allows to adjust the intensity from 0 to 1 milliamp.

The sensors make it possible to detect without difficulty the magnetic field produced by a current of 0.56 milliamp pulsed at 100 Hertz corresponding to the current of the cathode ray tube used.

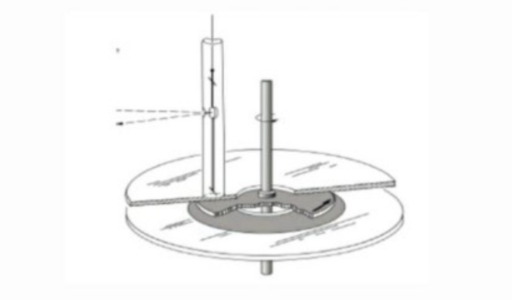
6 The cathode evaporates

When the electron gun heating resistor was switched on, the lanthanum hexaboride cathode evaporated. This resulted in an electric arc between the anode and the body of the gun after about twenty seconds when the anode was switched on.

Unfortunately, there is no equipment of this type with a beam intensity of a few tenths of a milliamp that allows relatively accessible magnetic field measurement. The guns still manufactured do not exceed one microamp and are also supplied with several thousand volts, which is for laboratory use. This is also the case for the guns of old cathode-ray televisions.

7 Rowland's Disk

Rowland's experiment is usually presented in a simplistic way as a compass deflected by an electrically charged rotating disk.



The reality is much more complex. A magnetic field is only observed near the edge of the disk.

Rowland used a kind of circular capacitor. A rotating positively charged conductive disk was placed between the negative plates of the capacitor.

Two compasses are suspended to a wire. The lower one is placed at the edge of the rotating disk. The small deviation resulting from the magnetic field is detected by a mirror attached to the wire.

The rotational magnetic field at a point on the disk is the integral of the fields of the turns travelled from the axis of the disk to the edge. It is therefore maximum at the edge of the disk.

In the framework of Maxwell's theory, this rotational magnetic field has a component in the plane of the disk if it is measured above the disk or in a plane perpendicular to the disk if it is measured on the edge of the disk.

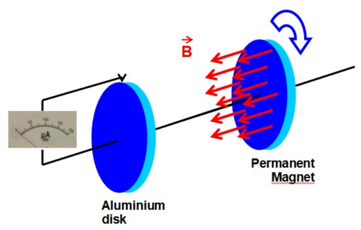
Maxwell's theory takes no account of the fact that electric charges have angular momentum. In reality, when the disk rotates, the angular momentum of the electric charges statistically aligns with the axis of rotation. And so the orientation of their magnetic field changes.

It is precisely this orientation that is the cause of the magnetic field of the Rowland's disk.

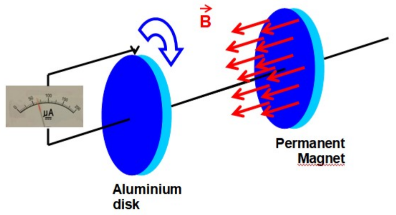
8 Faraday’s paradox

A conductive disk is placed in the magnetic field of a magnet. A brush collects the current at the periphery of the disk.

When the magnet rotates while the conductive disk is stationary, no current is detected in the disk. Faraday thought that the field of the magnet, with its flux lines, remained stationary during the rotation of the magnet. It is true that all the field lines are identical. Nothing would therefore change the behaviour of the electrons.



On the contrary, if the conducting disk rotates, it is traversed by a current. This paradox astonished Faraday. He expected to observe no current, since no current is observed in a circuit when the magnetic field and the surface are invariable. Faraday's law concerns a variable flux of the magnetic field.



Relativists have given an explanation based on reference frames. The speed involved in the Lorentz force would be relative to the reference frame in which the measurements are made, in the laboratory. They therefore claim that there would be a movement of electrons in a magnetic field and therefore a Lorentz force perpendicular to the field lines and to the tangential speed of the disk. The resulting radial current would be collected by the brush.

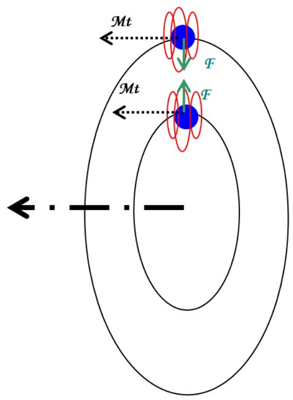
Why would this current not exist when the magnet turns? Wouldn't the movement be relative? Wouldn't the speed of the magnet belong to the same reference frame?

This mathematicians' explanation ignores the fact that electric charges have angular momentum.

In reality, when the conductor rotates, the angular momentum of the electric charges statistically aligns along the axis of rotation.

The intrinsic rotational magnetic field of the electrons behaves like that of a current line.

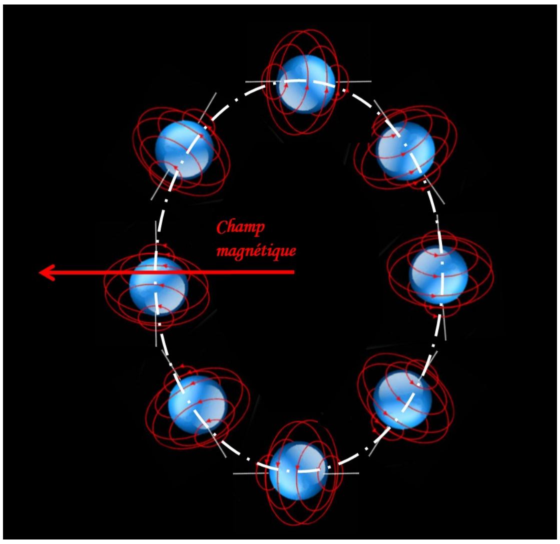
The current lines attract each other, but since there are more electrons at the periphery than at the centre, the electrons are attracted to the periphery. The excess electrons are collected by the broom.



The movement of electrons is not the cause of the magnetic field of electric currents. The electrons' own magnetic field has a rotational structure and is the one and only cause of the magnetic field of electric currents.

9 Magnets and Barnett effect

Consequently, the magnetic field of the electrons cannot be the direct cause of the fields of the magnets.



It is necessary that the electrons are organized in toroidal structures in the material of the magnets. The electrons of the magnets, included in such structures, generate a magnetic field similar to that of the magnets.

Such an arrangement could allow proposing a quantitative explanation of the Barnett effect by precession effect.

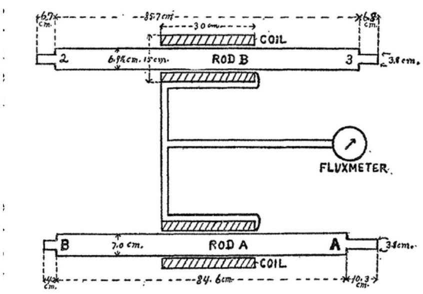


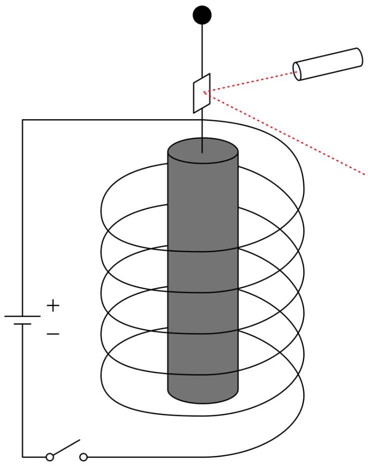
FIG. 3.

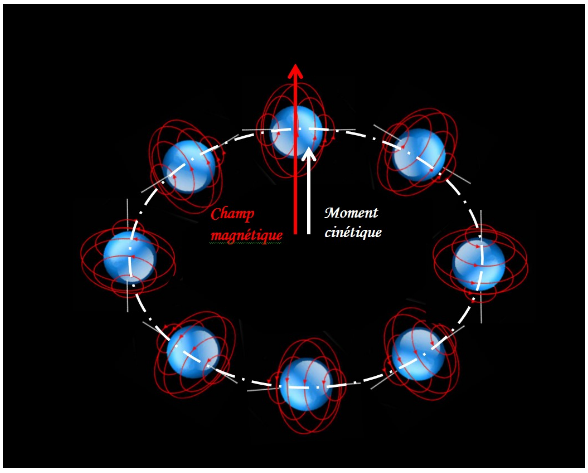
In the Barnett effect, rotating a magnet changes its magnetic field. The angular momentum of the toroidal structures is in their axis. These structures are put into precession. Their axis will tend to align with the axis of rotation. However, the axis of the angular momentum is also the axis of their magnetic field.

This results in a change in the magnetic field of the rotating magnet.

10 Einstein-de Haas effect

The Einstein-de Haas effect was predicted by Ampère as early as 1820. The magnetic field of a solenoid carrying a current causes the orientation of the toroidal magnetic fields of the magnet in the axis of the solenoid.





The magnetic field of the solenoid causes an additional alignment of the field of the toroidal structures of the magnet in the axis of this field and therefore also of their angular momentum. This results in a rotation of the magnet by this additional angular momentum

11 Maxwell

A consequence of this experiment is that the Maxwell-Ampere equation is false.

$$rot\left(\vec{B}\right) = \mu_0 \vec{J} + \frac{\partial\left(\varepsilon_0 \mu_0 \vec{E}\right)}{\partial t}$$

The magnetic field of an electric current is equal to the geometric sum of the magnetic fields of the electrons present in the conductor. The second term of the second member of the Maxwell-Ampere equation has no meaning.

Magnetic fields result exclusively from the magnetic field of electric charges.

The magnetic fields that appear when capacitors are charged result from the orientation of the magnetic field of the electrons by the electric field.

The disappearance of the displacement current invented by Maxwell, to solve a problem of mathematical divergence, has another consequence: the Maxwell-Hertz equation has no meaning.

$$rot\left(\vec{B}\right)=\frac{\partial\left(\varepsilon_0\mu_0\vec{E}\right)}{\partial t}$$

If the waves of Space result, in particular, from the movements of electrons and if they have effects on electrons, there is nothing to indicate that they are of an electromagnetic nature in themselves.

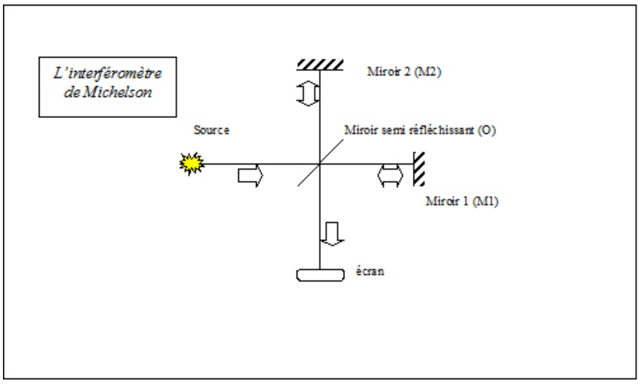
12 The relativists' illusion

The electromagnetic nature of light is a pure postulate of Maxwell.

Light is a wave phenomenon. Since Hertz's electromagnetic equation is wave-like, Maxwell immediately thought that light is therefore electromagnetic in itself. The goal of the positivists, and therefore Maxwell's goal, was to find mathematical equations for all phenomena of Nature. The problem therefore seemed solved.

However a serious difficulty arose. The Maxwell-Hertz equation is based on the conviction that magnetic fields result from the movement of electrons. This equation is therefore not invariant in a change of Galilean reference frame.

But as we have just seen, this is not the case. Speed plays no role for angular momentum. The problem of relativity therefore does not arise in any way.



Yet, some time before relativity could give the illusion of solving a problem that did not exist, the same basic relationships, the Lorentz formulas, had made it possible to explain the apparent impossibility of demonstrating the movement of the Earth around the Sun by the very famous Michelson experiment. It was a very convincing coincidence, it must be admitted.

Unfortunately for relativists, by giving up Maxwell's absurd equations, everything takes on another dimension.

By giving up postulating that light would be electromagnetic in itself, we return to the possibility of a medium in space carrying waves such as light.

So Descartes was right! Gravitation and light are carried by the same medium. This is the famous theory of vortices. Before going into the details of this theory, it is worth remembering that Descartes' theory explains the experiments of Michelson and Sagnac in a perfectly obvious way. The most remarkable thing is that Descartes had predicted the deviation of light by the sun.

13 References

Michael Faraday, Experimental Researches in Chemistry and Physics, Londres, Richard Taylor and William Francis, 1859. (National Library),

S.J. Barnett,« Magnetization by Rotation », Physical Review, vol. 6, 1915, p. 239–270

CEA/Yvanoe, schema du cyclotron

Lev Landau et E. Lifchitz, Physique théorique, Éditions Mir,

James Clerk Maxwell, Traité d'Électricité et de Magnétisme, Gauthier-Villars, 1989,

Michaud, A. (2013) On the Einstein-de Haas and Barnett Effects. International Journal of Engineering Research and Development e-ISSN: 2278-067X, p-ISSN: 2278-800X. Volume 6, Issue 12 (May 2013), PP. 07-11.

Olivier Darrigol, Les équations de Maxwell, Belin (2005).

Jean de Climont, Physics et Astronomie, Editions d'Assailly, 2024