Electron beams magnetic field is not a result of electron motion but of their intrinsic magnetic moment.

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Abstract : This paper proposes an experiment intended for showing that the magnetic field of electrons is not the result of their translation, but of their magnetic moment. The magnetic moments of electrons are aligned in the metal cathode until the electrons are ejected towards the anode, and then they pass through the hole provided for this purpose to form a cathodic beam. Electric fields do not change the orientation of the magnetic moments of the electrons. If this beam is deflected up to 90 ° by an electric field, the magnetic moments of electrons are no longer parallel to their direction of translation, thus the magnetic field of the cathodic beam should disappear or at least no longer be measured by coils placed in a plane containing the beam, unlike what can be observed before deflection.

Résumé : Ce rapport propose une expérience qui devrait permettre de montrer que le champ magnétique des électrons ne résulte pas de leur translation, mais de leur moment magnétique. Les moments magnétiques des électrons sont orientés dans la cathode métallique avant que les électrons ne soient éjectés vers l'anode, puis ne traversent l'orifice prévu à cet effet pour former un rayon cathodique. Les champs électriques ne modifient pas l'orientation des moments magnétiques des électrons. Si ce rayon est dévié à 90° par un champ électrique, les moments magnétiques des électrons ne seront plus parallèles à leur direction de translation, le champ magnétique du rayon cathodique doit disparaître ou du moins ne plus pouvoir être mesuré par des spires placées dans un plan contenant le rayon cathodique, contrairement à ce qui pourra être observé avant déviation.

Key words: Electron ; magnetic field ; magnetic moment ; cathodic beam ; electrical current ; electric field.

Content

1. Rationale of the experiment

The magnetic field of electrical currents is presently considered as an effect of the translation speed of electrons within conductors. This effect was first discovered by Gian Domenico Romagnosi in May 1802 and reported to the French Academy of Science which didn't register the discovery. The Danish scientist Hans Christian Ørsted made the same discovery twenty years later and the Danish Academy published immediately his report. Nevertheless, Ørsted recognized that he was informed of Romagnosi's experiment.

Cathodic beams made of electrons have also such a magnetic field.

But electrons do have an intrinsic magnetic momentum causing all magnetic properties of matter. So that there are two co-existing potential causes of the magnetic field by one very single electron flows: translation speed and intrinsic magnetic momentum. The intrinsic magnetic momentum of electrons is presently considered as a result of electron spinning. Perhaps, but within a conductor or within a cathodic beam, electrons have finally two potential ways of producing the magnetic field. This is too much. This is against the specific causal uniqueness principle applicable for basic concepts of physics as well as for geometry. It is also against the Ockham's simplicity principle.

Comment 1: It seems difficult to rule out the magnetic momentum as a cause of magnetism without finding another way for explaining magnetism of matter. In the other hand, keeping the translation speed as a cause of magnetism cannot solve the problem because spinning electrons would anyway make a magnetic field potential cause to exist additionally in conductors. So that translation of electrons should be ruled out as a cause of magnetic field.

Comment 2: Within a conductor the orientation of the intrinsic magnetic momentum of electrons is produced by their motion within the conductor either because the electric field inside the conductor, producing the current, modify the atomic arrangement of the conductor or only because, while moving, the electrons intrinsic magnetic momentum is oriented by the existing atomic structure of the conductor. This is why the orientation of the electrons intrinsic magnetic momentum of a cathodic beam shall be produced before leaving the cathode.

The same apply to beam of positrons or whatever other particle with an intrinsic magnetic momentum.

Comment 3: There are at least one solution to solve the topological problem of the magnetic fields of magnets and electrical currents.

In order to produce a magnetic field complying with experiments both for electrical current (and cathodic beam as well) and magnets, the following provisions are necessary:

The common orientation of magnetic moment of electrons within current shall produce the observed magnetic field with the well known rotational topology. This will explain the "striction" of the cathodic beams (the beams become progressively sharper) in a very similar way as presently. The change is that such an arrangement of the intrinsic magnetic moments of electrons will directly produce on moving electrons themeselves the transversal acceleration causing the striction although in the present approach this is a two step process: the motion of electron produce a magnetic field which in turn deviates moving electrons. The new approach proposed by this paper is simpler.

The consequence is that for magnets, the magnetic field is not produced directly by the magnetic moment of electrons. Electrons are arranged in toroidal rings. This may be very useful to explain quantitatively the magnet rotation effect in the Barnett experiment while not impairing the interpretation of the Einstein-de Haas experiment. A significant additional amplification is obtained through the ring swinging under the centrifugal acceleration. For the time being the experimental result has never been justified quantitatively.

Comment 4: In line with the axiomatic approach, it could be postulated that the magnetic momentum of electrons is always kept stochastic both within conductors and within cathodic beams. If they are distributed at random, the magnetic momenta of electrons would not create any magnetic field.

An other solution could be to postulate that the electrons in the beam are unpolarized. That is to say, half the electrons would have magnetic moments pointing one way, and the other half will be the opposite. It is nevertheless difficult to explain how such an arrangement may occur.

The experiment proposed by this paper could prove that it could be the case if there is a magnetic field after the deviation of the cathodic beam.

Comment 5: The new approach of the magnetic field of electrical currents is changing the Maxwell-Ampere and Maxwell-Hertz equations. The charge motion shall be replaced by the intrinsic magnetic moment in both equation. And the result is that these equation are not changed by the galilean transformation as magnetic moments are covariant within this transformation.

2. Experiment protocol

(see figure page 9)

The spherical portion of an original Perrin tube shall be replaced by a pyrex tube of 40 mm diameter bent at the middle by 90°. It could be for instance a NARVA PR2 tube still available in the Internet. Figures hereafter are suitable for this kind of tube.

The magnetic field of the cathodic beam will be measured in the straight part of the modified Perrin tube and after the curved part.

The anode voltage of 400 V to crest will be two waves rectified, but not filtered , so that the current induced in the sensor can be detected by an analogue to digital converter after an amplification by an Operational Amplifier with a factor of 200. The anode voltage will be maintained throughout the measurement. Cathod heating will be supplied by a DC 6.5 V power supply.

The cathodic beam deflection up to 90° will be obtained by an electric field produced by two semi-toroidal plates placed on each side of the tube in its curved part. They will be supplied with an adjustable DC power supply from 200 to 2000 V, rectified and filtered.

In this experiment, two identical sensors are needed with 12 coils of 1300 loops each connected to a resistor 1MΩ and connected to an operational amplifier with an amplification factor of 200.

One of the sensors will be placed before the curved portion of the tube and the other one after. Both signals delivered by the AD converter will be sent to a data acquisition module connected to a PC.

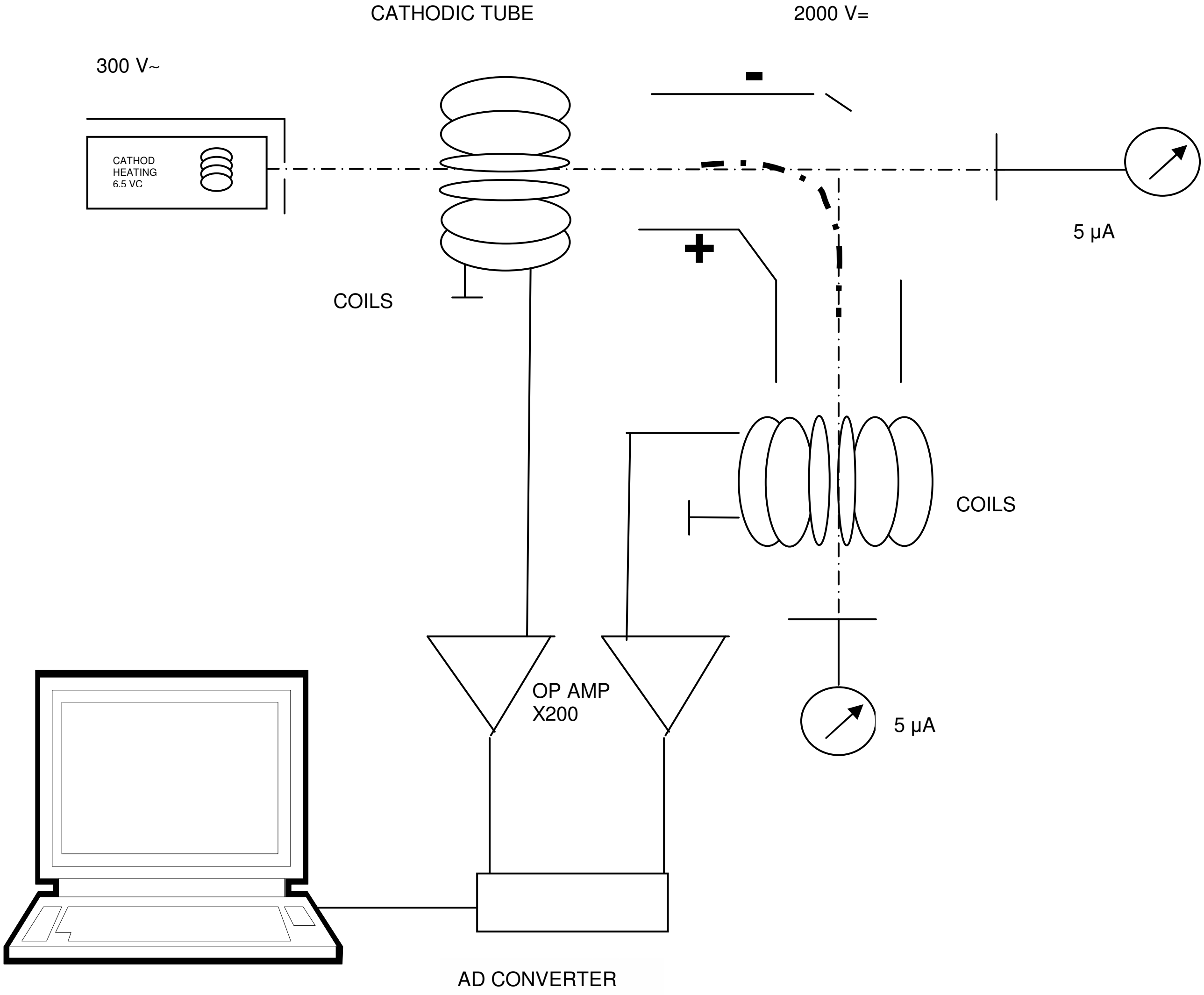
The magnetic moments of electrons are assumed to be aligned in the metal cathode until the electrons are ejected towards the anode, and then they pass through the hole provided for this purpose to form a cathodic beam.

Electric fields do not change the orientation of the magnetic moments of the electrons. This beam is deflected up to 90 ° by the electric field provided in the bent part of the tube. The magnetic moments of electrons are no longer parallel to the direction of the electrons translation, thus the magnetic field of the cathode beam should disappear or at least no longer be measured by coils placed in a plane containing the beam, unlike what is observed before deflection.

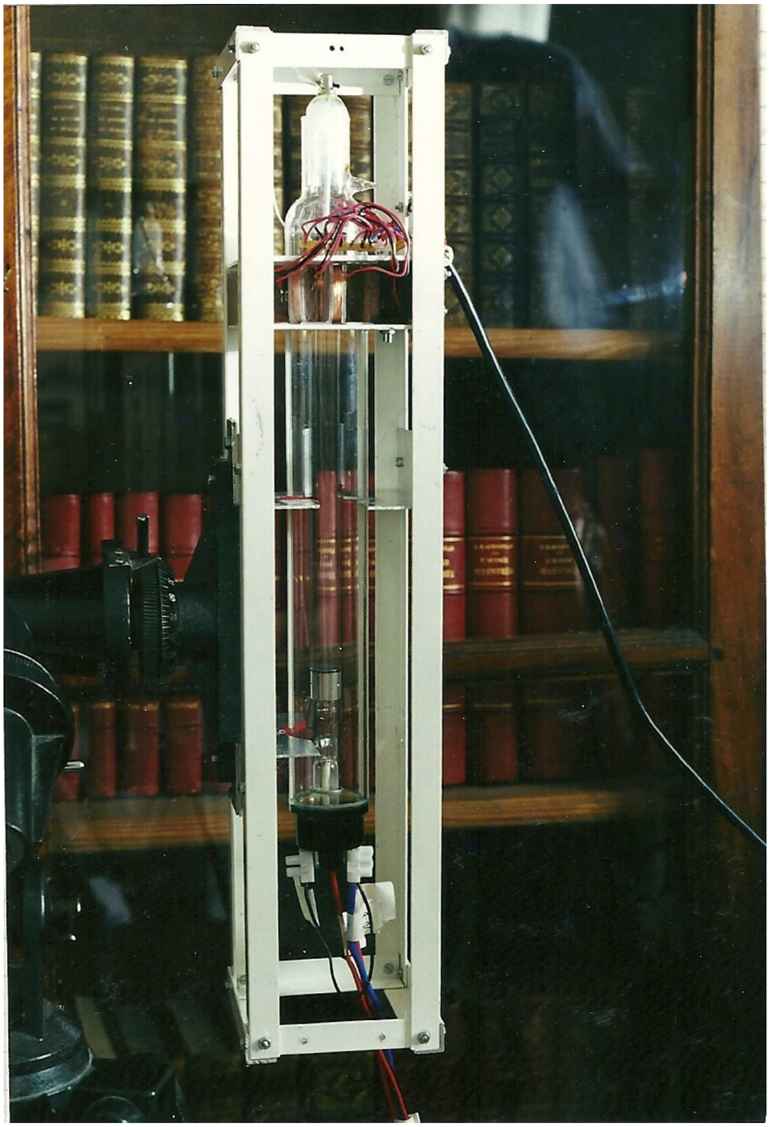
The first sensor should show the magnetic field of the cathodic beam as it has been checked by the author in May 2000 with a straight tube. The second sensor, located after the 90° deviation of the cathodic beam in the elbow of the tube, should show nothing.

Conversely, if the 90° deviation of the cathodic beam is obtained by a **magnetic field**, then the second sensor should show the same magnetic field of the beam as the first sensor. This is because the magnetic field changes not only the beam direction but also the intrinsic magnetic moment of electrons.

3. Figures


CATHODIC TUBE
2000 V=
300 V~
-
CATHOD
HEATING
6.5 VC
5 µA
+
COILS
COILS
OP AMP
X200
5 µA
AD CONVERTER

Example of a modified Narva PR2 Tube used by the author to measure the magnetic field of an electron beam magnetic field. The tube of the new experiment proposed by this paper shall be bent by 90° in the middle. The author is not able to proceed with this new experiment by himself mainly because the electric field necessary to deviate the beam needs a much too high voltage and cannot be obtained outside a certified laboratory for safety reasons.



The coils and the overall experimental device for the straight tube.