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

(May 2014)

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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.

1. Rationale of the experiment

The magnetic field 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 a magnetic momentum causing all magnetic properties of matter. So that there are two co-existing potential causes of the magnetic field of electron flows: translation speed and magnetic momentum. 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.

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: There are at least one solution to solve the topological problem of the magnetic fields of magnets and electrical currents: electrons may be arranged in ring structures within magnets. This would provide for a significant additional amplification of the magnet rotation effect in the Barnett experiment while not impairing the interpretation of the Einstein-de Haas experiment.

Comment 3: In line with the axiomatic approach of pure science, 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. The experiment proposes 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 4: The logical contradiction of the Newton-Maxwell sequence of postulates is related to Maxwell equations lack of Galilean covariance as stated by Poincaré. This is not the case for Newton laws. But the magnetic moment is also Galilean covariant; so that the Poincaré's paradox is disappearing when removing the translation of electrons as a cause of magnetism.

Comment 5: The simplicity principle (Occam's razor) is not used in this statement. The author consider it more like an aesthetic principle than like a logic principle. He would not consider it as compulsory although he is fully convinced that the result of the required change is in line with this principle.

2. Experiment protocol

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.

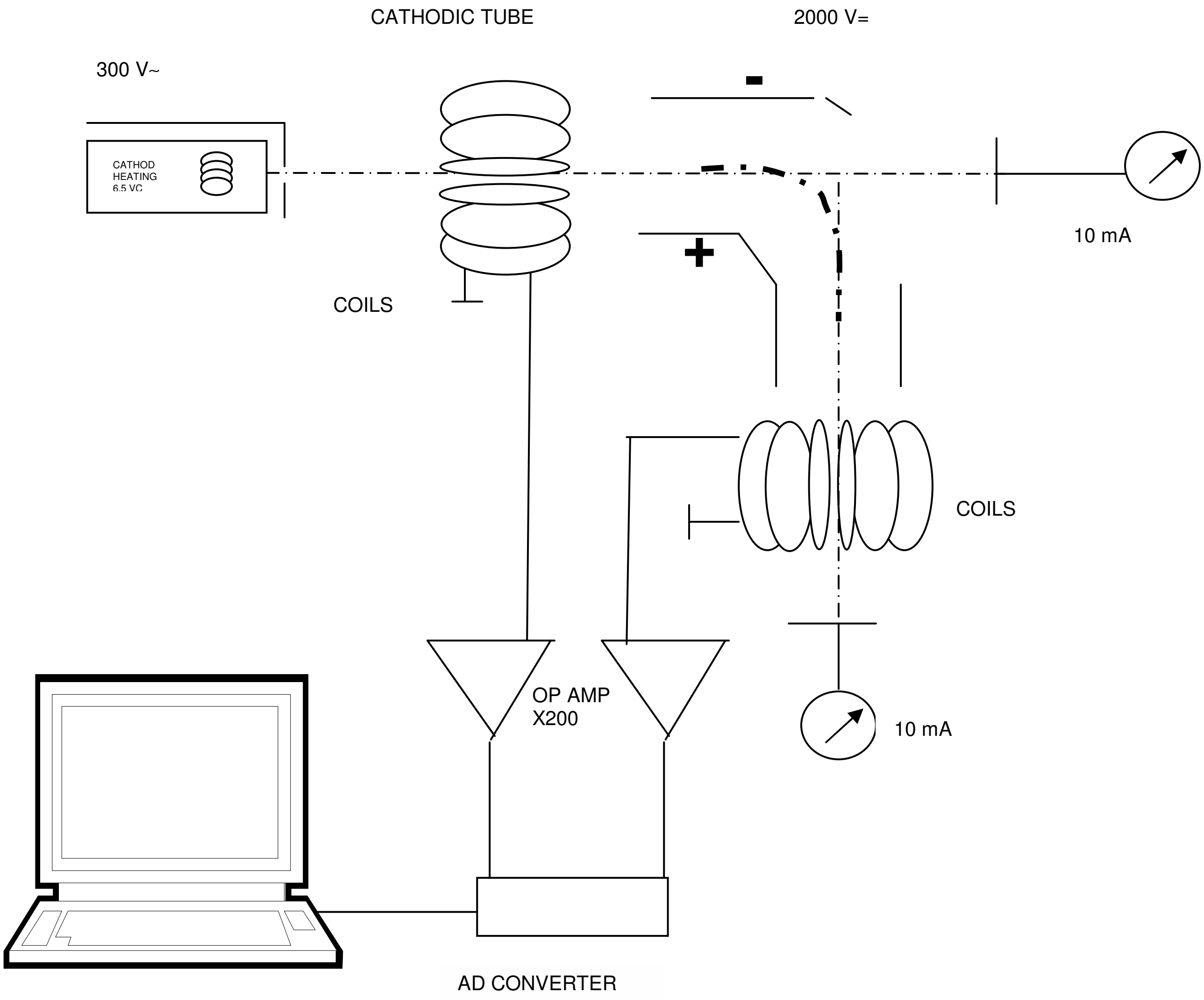
One of the sensors will be placed before the curved portion of the tube and the other one after. Both signals delivered by the AD converter will be sent to a data acquisition module connected to a PC.

The magnetic moments of electrons is 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. Conversely the second sensor, located after the elbow of the tube should show nothing.

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.


CATHODIC TUBE
2000 V=
300 V~
-
CATHOD
HEATING
6.5 VC
+
10 mA
COILS
COILS
OP AMP
X200
10 mA
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.