An experiment does not support the notion that the magnetism is a relativistic effect of Electrostatics

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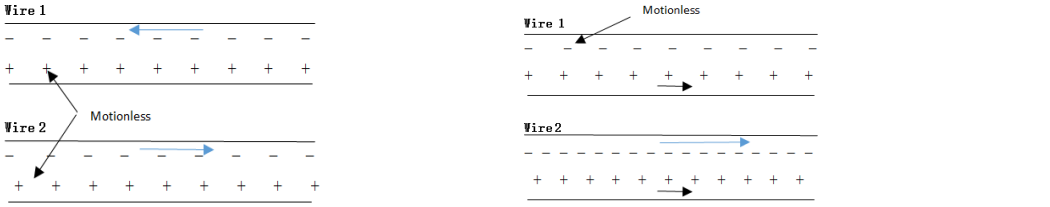
Abstract: In order to prove if the magnetism is a relativistic side effect of the electrostatics, an experiment was designed and performed. The experimental result does not support the notion that the magnetism is a relativistic side effect of Electrostatics.

Key words: magnetism and relativity; the essence of magnetic field

Introduction

In text books[1,2] and article,[3] Magnetism is thought as a relativistic side effect of Electro Statics, which can be derived from electrostatic interaction and Lorenz length contraction in charges moving direction. In this view, the magnetic field is not a fundamental field. A popular derivation follows Purcell who presented this derivation in his 1963 textbook [1]. The system of a current in a neutral wire with a charge nearby or two parallel current in a neutral wire was analyzed based on electrostatic interaction and relativistic theory. In this analysis, the magnetic force is explained as the charges in one wire feeling more same type charges (repelling) or more opposite type charges (attracting) in the other wire when observing in the frame of the moving electrons, as shown in figure 1. The analysis looks satisfactorily explained the magnetic interaction phenomena and predicts the same experimental results of the classical electromagnetism theory. There are also publications disagreeing this viewpoint.[4,5,6] However, all of these are only based on theoretical deduction and analysis, there have been seen any experiments to verify it. In this paper, an experiment was designed and performed aiming to verify this notion. The result of the experiment dos not support that the magnetism is a relativistic effect of the electrostatics.



a. In lab frame, two metal wires with different direction of currents. The currents were caused by electrons' drifting.

b. In the frame that the electron of wire 1 is static. The Lorenz contraction happens for the positive charged ions in the wire 2, but the Lorenz contraction for the electrons in wire 2 is more intense.

Figure1. Electric currents in two parallel metal wires

Considering two parallel wires, a magnetic force between the two wires will be created when

electric currents flow through the wires. The magnetic force may be attractive or repulsive depending on the current direction. To explain the magnetic field is really very different from electric field, a conductor plate was put in between the two wires, as shown in figure 2 and the same interaction of the two wires were observed as if the plate was not there.[2] But, we know that a conducting sheet in between two electric plate cannot eliminate the electric field outside the conductor,[1] as shown in figure3, so this experiment was not sufficient to prove if the magnetism is the relativistic effect of the electro static or not.

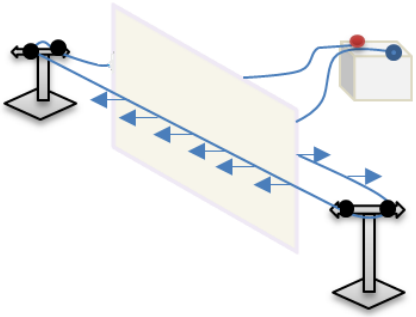


Figure2. A metal plate is put in between the two wires and the magnetic interaction is not affected.

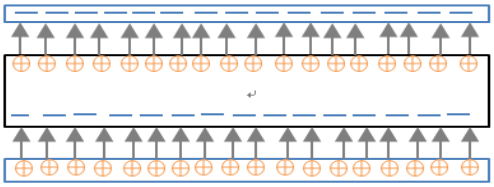


Figure3. A conductor plate is in the gap of parallel plate capacitor. The electric field outside the conductor is not affected, although the electric field within the conductor is zero.

Experimental design

It is well established a principle and a fact that electric field can be screened by conductor covers. In our magnetic experiment for two parallel wires, the wires were wrapped up with a conductor (alumina) foil. So, if the magnetic force is the relativistic side effect of electrostatic force, it should be screened and eliminated by the alumina cover. The experimental designs can be seen in figure 4 and figure 5.

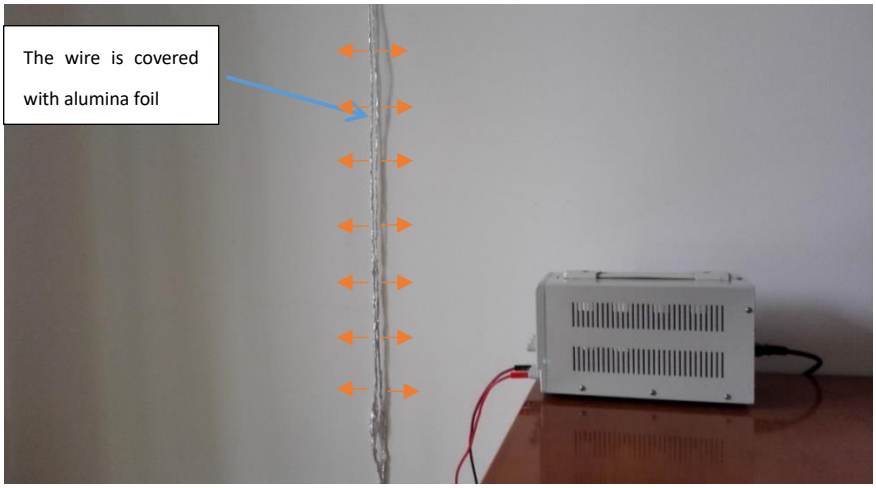


Figure4. The two wires were wrapped up with alumina foil.

Figure5. One wire was wrapped up with alumina foil and the other was put in an alumina tube.

Results and discussion

In the experimental design of figure 4 and figure 5, when currents flew through the two parallel wires which covered with alumina sheet, we saw the two wires repelling each other as if there was no the alumina cover. The experimental results showed that the magnetic interaction between the two wires could not been screened or eliminated by conductor covers. So the results do not support the notion that the magnetism is a relativistic effect of Electrostatics.

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