# Is there force acting on the magnet moving across an electric field?

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**Abstract**

In terms of the symmetric perfect and analogy of Lorentz Force law, a Counterpart Lorentz force is proposed in this paper. Similar to a Lorentz force when a charged particle moving across a magnetic field, an analogical force may act on a magnet or a magnetic domain when it moving across an electric field. Aimed to verify if this force is really existed, an experimental design is also described here.

## Introduction

In electromagnetism, the Lorentz force is the magnetic force on a point charge due to magnetic field. A particle of charge *q* moving across a magnetic field **B** with velocity ***v*** experiences a force

$$F = qv \times \mathrm{B}$$

In terms of symmetry, if there is a similar force for the magnetic monopole moving across an electric field, the classical magnetism will looks more perfect. Analogically the Lorentz force law, we may imagine that a magnetic monopole may experience a similar force perpendicular to both the electric field and the velocity when it moving across the electric field. We may boldly guess that this force has a similar expression as the Lorentz force law,

$$F = pv \times \mathrm{B}$$

Where, like *q* is the charge quantity, the *p* represents the quantity of the magnetic monopole, **v** velocity, **E** the electric field.

However, the magnetic monopoles have never been observed so for despite its existence is predicted by some modern theories [1-6]. So, it is impossible for us to perform Lorentz force like experiment with a nonexistent magnetic monopole. However, we have another way to experimentally verify if this force is really existed. For sake of convenience in discussion, here name this force Counterpart Lorentz Force.

## Theoritical analysis and experimental design

If an electric dipole moving across a magnetic field, the dipole will incline to align in the direction perpendicular to both the velocity and the magnetic field due to the different action direction of the Lorentz force on the two electric poles, as shown in **Figure 1**. Analogically, if a magnet, or a magnetic domain moving across an electric field, we may imagine that it will incline to align in similar way due to the Counterpart Lorentz Force on the two magnetic poles, as shown in **Figure 2**. So, instead of magnetic monopoles, we can use magnetic domains to verify the existence of this force. We know that a magnetic material is composed of magnetic domains. Thus, a piece of magnetizable material might be magnetized after moving across an electric field, as shown in **Figure 3**. So, we will use magnetic materials moving across an electric field to design the experiment.

In the experiment, a plate is placed in a electric field formed by two charged discs. A magnetizable rode is fixed in the plate along the radical direction. For details please see **Figure 4**. During the experiment, we turn the axis and the plate will rotate in high speed, but the two charged discs keep stationary. Thus, the rode will be moving across the electric field.

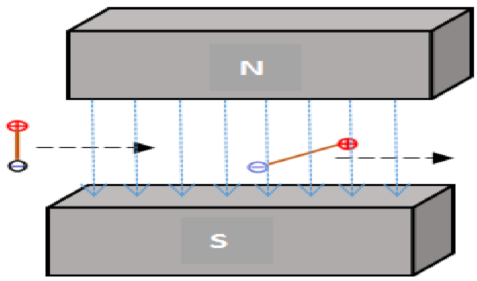


**Fig. 1.** An electric dipole moving across a magnetic field

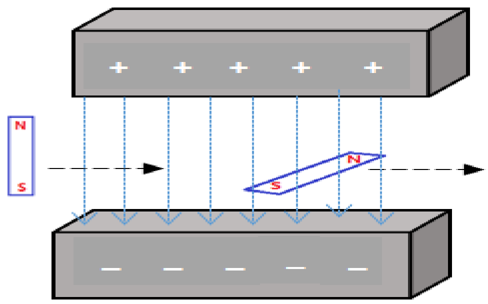


**Fig. 2.** A magnet moving across an electric field

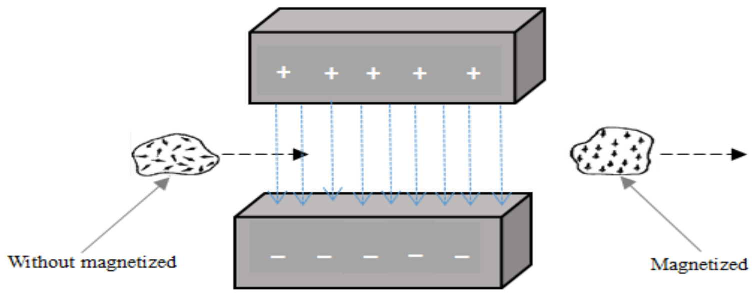


**Fig. 3.** A bulk of magnetizable material moving across an electric field

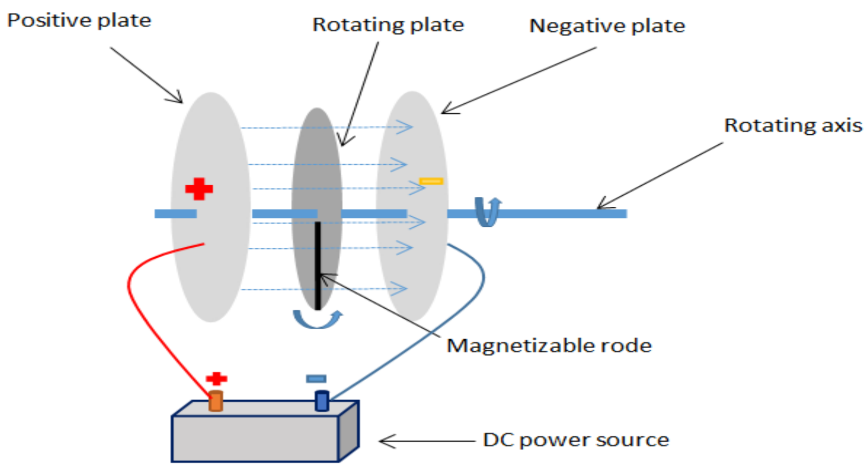


**Fig. 4.** Experimental design to verify the existence of this force

## Discussion

Before turning the plate, we have the rode in unmagnetized state. Then we rotate the plate for a while, so the robe will be moving across the electric field. After the rotating, we measure the magnetic property of the rode. If it is magnetized, the existence of the Counterpart Lorentz Force is proved. In the other words, if this force is really existed, a magnetic material will be magnetized after moving across a strong electric field. It is reasonable that the stronger of the electric field and the faster of the rotating, the more possible this Counterpart Lorentz Force is to be observed.

If this force is really observed experimentally, it might be served as an indirect proof of the magnetic monopole. At least to a certain extent, it increases the hope for these people who believe the existence of the magnetic monopole.

## References


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