How to defend the validity of Newton's 3rd law in electro-dynamics using four experimental results

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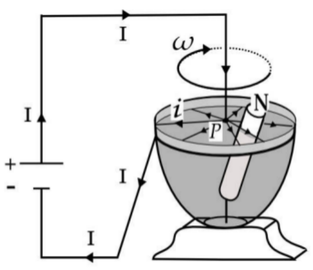
Introduction

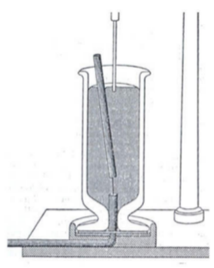
Someone may say that Ampère adopted Newton's 3rd law arbitrarily. But...

"I confess that this experimental proof of a principle which is nothing else but a necessary consequence of the first laws of mechanics appears to me completely useless, as it should have been clear to all the physicists who considered this principle one of the foundations of science. I would not have made this observation, if it had not been assumed [by others] that the mutual action of one element of a conducting wire and of a magnetic molecule, consisted in a primitive couple composed of two forces equal and parallel without being directly opposed, by virtue of which a portion of current which is located inside a magnet might move it; [this] supposition is contrary to the principle which is being discussed here, and is denied by the previous experiment [...]."

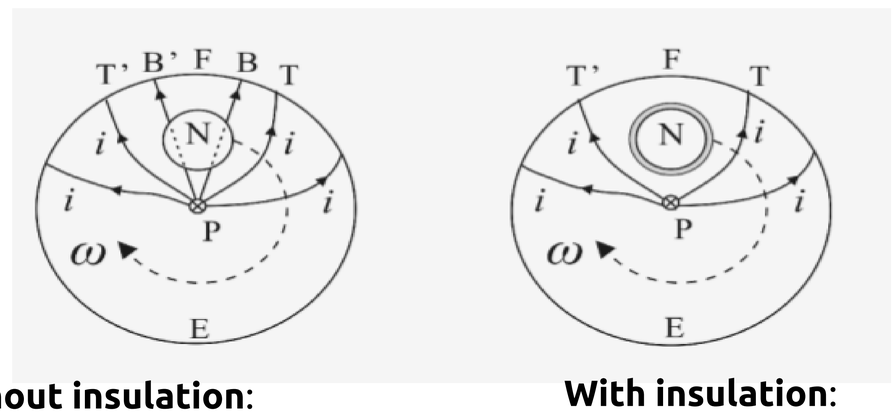
(A.-M. Ampère, *Théorie* (1826), pp. 171-172. In: Assis and Chaib, *Ampère's Electrodynamics* (2015), p. 448)

Faraday's Experiment





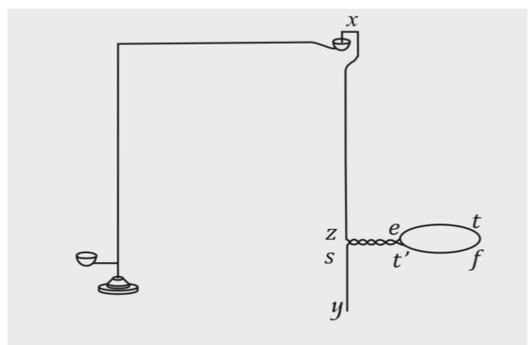
Ampére's Variations (I)

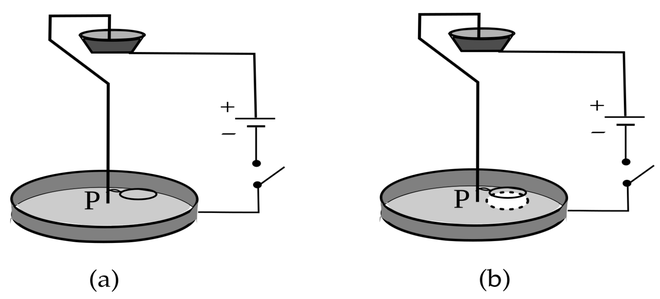


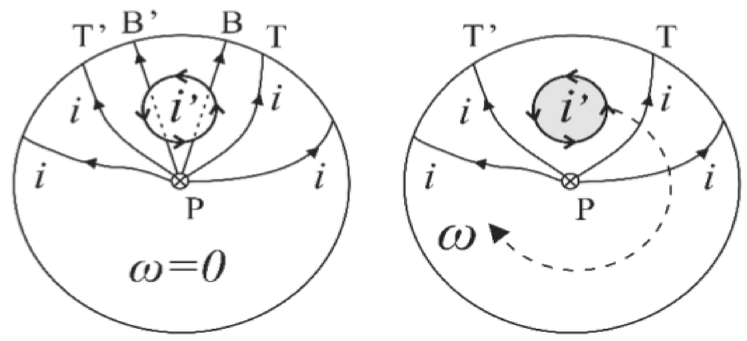
Without insulation:
The current *flows through* the inner space of the magnet / coil.

With insulation:
The current *does not flow through* the inner space of the magnet / coil.

Ampére's Variations (II)

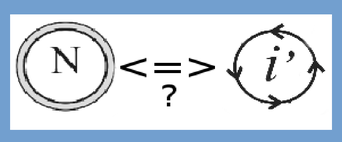




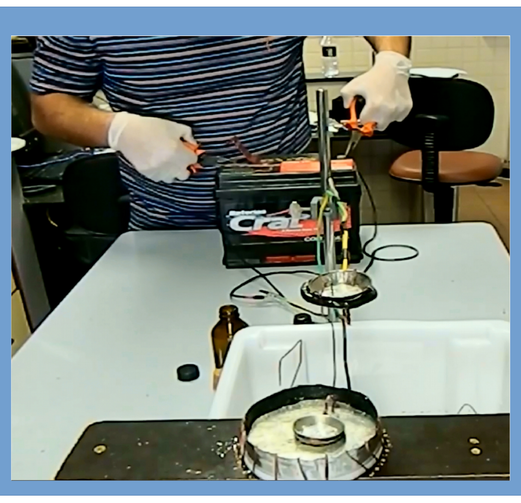


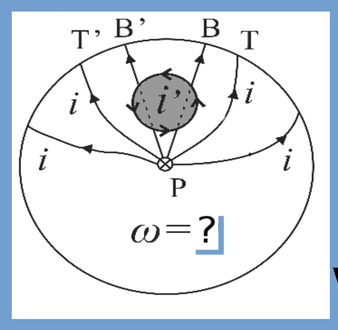
OUR CONTRIBUTION

However one must admits Ampère's hypothesis that a magnet is an electrodynamic effect.



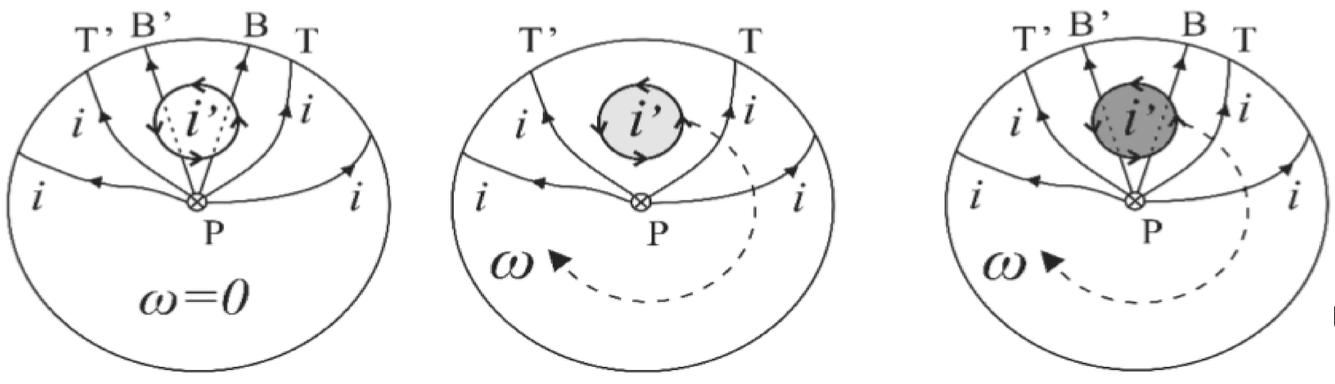
In order to avoid this step we propose (and we have performed already) a complementary experiment.





In this experimental variation *the current flows through* the inner space of the coil. However the medium conductor inside the coil is attached to it.
Based on the results above, what result you expect? Do the coil will move or will not?

OUR RESULT



With those three results we can affirm:

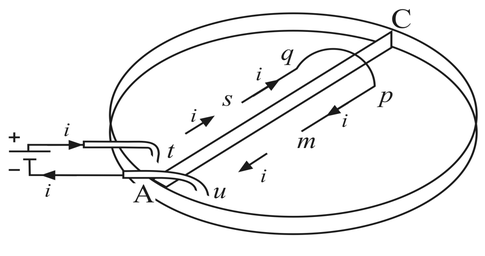
1. The main action that made the coil to move comes from the currents in the mercury.

2. THE ELECTRODYNAMIC ACTION ORIGINATED OF A SOLID SYSTEM ON ITSELF HAS A NULL RESULTANT.

this experimental result is independently from the conception of the interaction

(mediated, a distance, retarded, momentum in the field, etc.)

A Complement



To model the result of Ampère's bridge with Grasmann's force, one must assume the bridge itself as the origin of the actions responsible for its own movement!
(Assis and Bueno, 1996)

Once the elementary torque is accepted, one is obliged to admit at any rate that there must be some phenomena where the actions which are originated from the same solid system are responsible by the change on the relative motion of the solid itself.
(See also: Assis and Chaib,2015, *Ampère's Motor*)

Paper

Video

CONCLUSION

The experimental results lead to conclude that a solid system cannot cause any change to its relative motion due to electrodynamic) actions that stem from itself. Thus, the elementary torque hypothesis is in contradiction to the experimental conclusion.

In fact, to assume the validity of Newton's 3rd law in electrodynamics is the simplest conclusion — i.e., with less arbitrary assumptions — that one can take from those experiments.

Ampère's force is the only model of interaction between current elements that implements this principle!