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# Synthesis of the inconsistency of the Lorentz force law

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I have given several proofs of an inconsistency of the Lorentz force law, for example, in "Mathematical cause of the existence of the remaining resultant internal Lorentz force" http://pengkuanem.blogspot.com/2012/04/mathematical-cause-of-existence-of.html

In this article, I have proven mathematically that the Lorentz force internal to a triangle coil cannot sum to 0, because the magnitude of the Lorentz force is approximately a parabola of the height whereas the force that makes 0 sum varies linearly with the height.

One of the objections to me is: "Your mathematics are wrong". This objection could be receivable if this were an unique mathematical proof. But this is not the case, for I have given another mathematical proof, in "Proof of the remaining resultant Lorentz force internal to a triangular coil"
http://pengkuanem.blogspot.com/2012/04/analyze-of-lorentz-forces-internal-to.html

This proof is a rigorous derivation of the analytical expression of the sum of the Lorentz force internal to a triangle coil and it is (see the corresponding document):

$$\boldsymbol{F}_{res} = \frac{\mu_0}{2\pi} I^2 \sin(\theta)\left( \int\limits_{\substack{AB \\ (q)}} \int\limits_{\substack{BC \\ (p)}} \left( \frac{dl_q}{r_{pq}^2} \cos(\beta) \right) dl_p + \int\limits_{\substack{CA \\ (q')}} \int\limits_{\substack{BC \\ (p')}} \left( \frac{dl_{q'}}{r_{p'q'}^2} \cos(\gamma) \right) dl_{p'} \right) \boldsymbol{e}_y$$

This is an independent proof of the same inconsistency. Along with the numerical computation that gives a remaining resultant force of 35.21 in the y direction (see the same document), these are 3 serious proofs that make the objection of erroneous mathematics no longer hold.

An other objection is: "You are not allowed to use the Lorentz force law to calculate the force of a coil on itself". But, can we distinguish clearly internal force from external one? Let us see the Figure 1, where the arrows indicate currents. We have 2 coils in the part (a). The forces are external to each coil and are calculated with the Lorentz force law below:

$$d^2\boldsymbol{F} = d\boldsymbol{I}_1 \times \left( d\boldsymbol{I}_2 \times \frac{\boldsymbol{r}}{r^3} \right)$$

In the part (b), we have put 2 bridge wires that carry the current between the same 2 coils, and they become now a single coil. In this case, the former external force become internal. However, the physical forces do not change since the magnetic effect of the bridge currents cancels out. Should we stop to use the Lorentz force law just because of the bridge wires?

If we have a triangular coil like the one in the part (c), the forces are internal and the Lorentz force law is not usable. But we can get around this prohibition by cutting the triangle into 2 coils with bridge wires like that in the part (d). This way, the internal forces become external.

We see that internal and external forces are not well distinguishable. On the other hand, when 2 coils are distinct, the Lorentz force law gives a result that respects the third Newton's law, whereas for forces internal to one coil, the Lorentz force law gives another result that violate

the third Newton's law. If a theory gives 2 different results for the same physical phenomenon by following 2 different ways of application, the theory is flawed.

The objection of the type "You are not allowed to …" is a reduction of the domain of validity. If the domain does not cover all possible physical cases, the theory is not complete. If the domain is blurry as explained above, the theory is even not well defined. So, the Lorentz force law describes magnetic force only with limited accuracy.

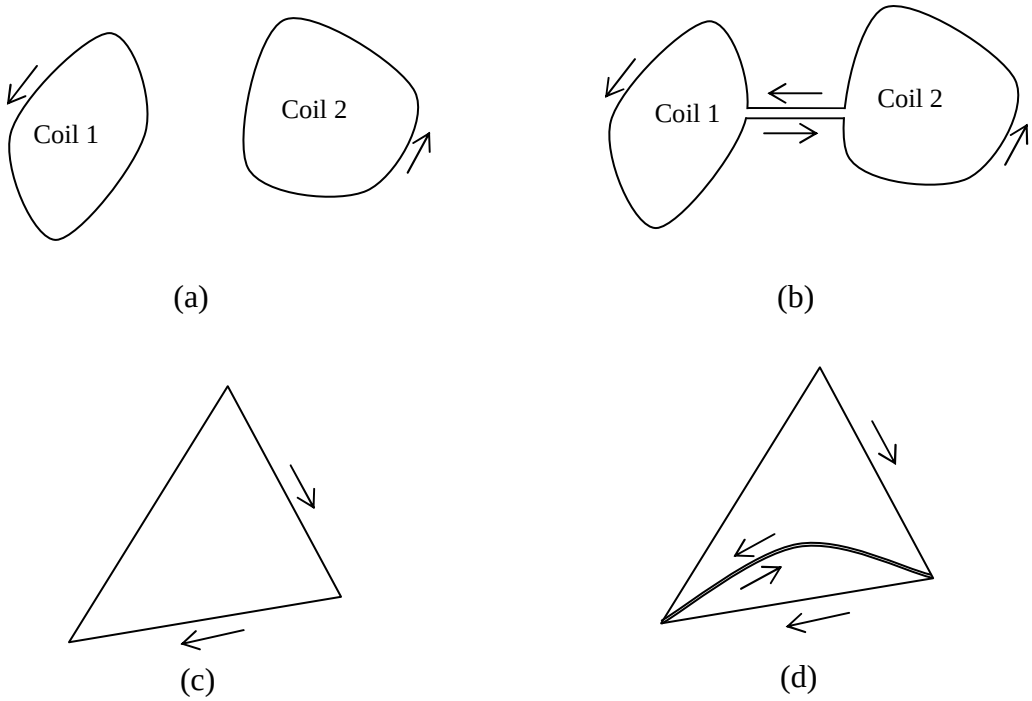


**Figure 1**

For those who want to "feel" this inconsistency, let us see the example of the Figure 2. This is a pentagon with height h. The Lorentz force on the bottom is $\mathbf{F}_{bottom}$, that on the angular top is $\mathbf{F}_{top}$. The height is sufficiently long that the magnetic field generated by the top is negligible at the bottom and vice versa.

Thus, the magnetic field at the bottom comes only from the lateral sides, and $\mathbf{F}_{bottom}$ is constant whatever the top's shape is.

On the other hand, the force on the top is mostly produced by the interaction between the broken sides *s* and *t* (see part (a) of the Figure 2), which is variable with the angle of the summit, as illustrated by the 3 different $\mathbf{F}_{top}$ corresponding to 3 different shapes. In consequence, the z component of the sum $\mathbf{F}_{bottom} + \mathbf{F}_{top}$ , which is the resultant force, is variable, hence non null.

We can even make the top tilt out of the plan (see the part (b) of the figure) and produce an y component for the Lorentz force that can hardly be canceled by the forces on the other sides. So, the Lorentz force's sum internal to this pentagon coil is not 0, breaking the third Newton's law and the energy conservation law (if the coil moves in the direction of the resultant force, it would do work).

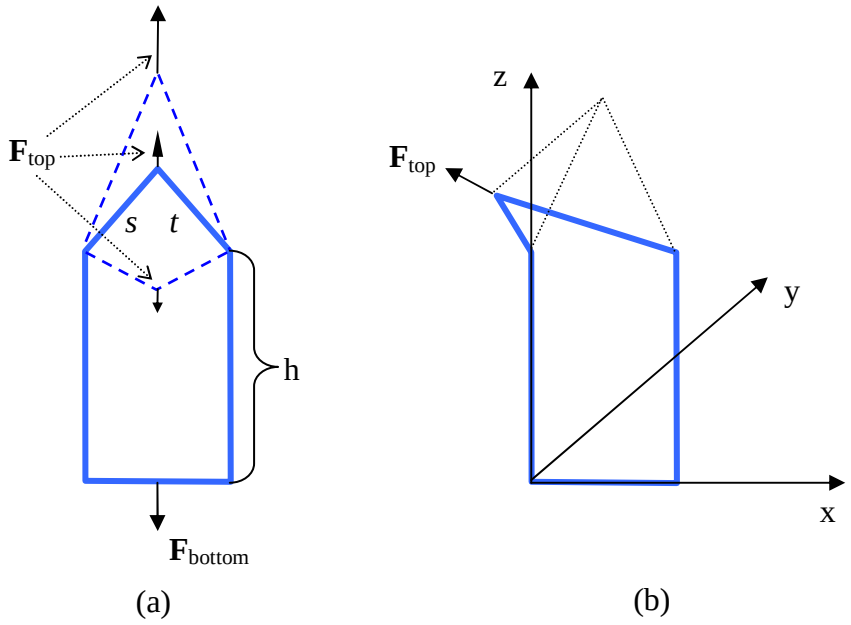


**Figure 2**

The above 2 mathematical proofs, the numerical computation, the vagueness of the validity domain (the Figure 1) and the geometrical explanation (the Figure 2) are sufficient evidences for drawing the important conclusion:

## The Lorentz force law is inaccurate.

The difference between the prediction of the Lorentz force law and the actual physical fact can be tested by experiment. This test will give experimental evidence of the inconsistency. One design of the experiment is described in the document "Lorentz torque experiment" .
http://pengkuanem.blogspot.com/2012/03/lorentz-torque-experiment.html

This design makes use of coils, current source and oscilloscope. It is so simple that any laboratory of physics can carry it out within weeks. It is also such a ground breaking one that it will surely bring honor to the experimenters. Because of these reasons, I think that there will be hard race to make public the experimental result for securing priority and the result will probably be announced through public media rather than scientific ones. Indeed, this is the most rapid way.

Please also read the document "I need help"
http://pengkuanem.blogspot.com/2012/04/i-need-help.html