A 1.95 m long solenoid exerting Aharonov–Bohm force on a coil

Peng Kuan 彭寬 *titang78@gmail.com*

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Abstract: This experiment shows the magnetic force on a coil exerted by the magnetic field of a long solenoid that should be zero.

Aharonov–Bohm effect shows that electron beam can be deflected in the middle plane of a long solenoid where the magnetic field is zero for classical electromagnetic theory. If the deflection is due to a magnetic force, it would push a current currying coil too. This experiment shows that a long solenoid of 1.95 m (6.4 foot) effectively makes a current currying coil move and proves that this magnetic field is not zero. Here is the video of the experiment: https://youtu.be/FcVH-VIjVRU

1. Experiment

This experiment is done using a 1.95 m long solenoid and a coil located in its middle plane. We will see if the coil rotates or not when the current is on. See Figure 1.

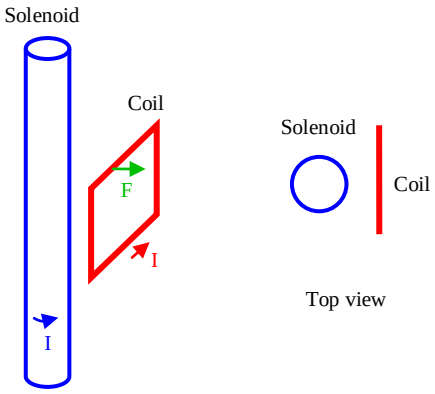

Figure 1

Here are the parameters of the solenoid and the coil.

Solenoid

Length: 195 cm
Diameter: 5 cm
Number of turns: 3900
Current: 5 A

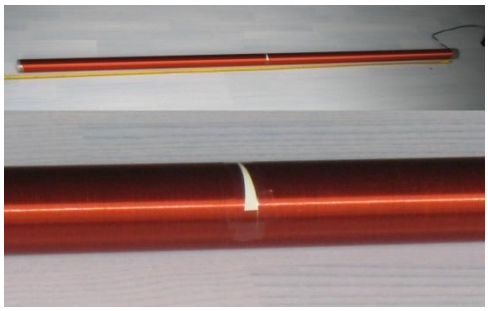

Figure 2

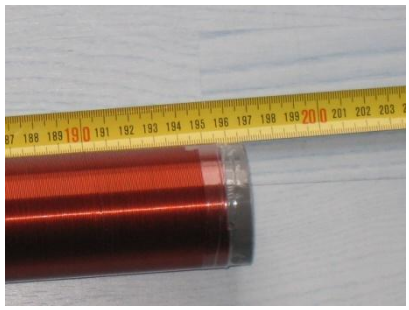

Figure 3

Coil

Height: 7 cm
Width: 3 cm
Number of turns: 3
Current: 5 A

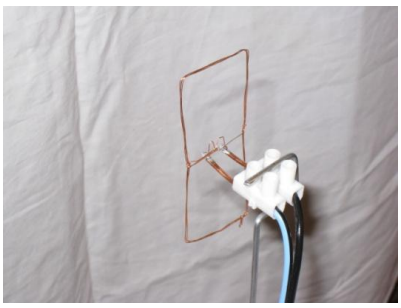

Figure 4

In order to eliminate the force due to terrestrial magnetic field, alternating current is used. The solenoid and the coil are connected in series and the currents in them are in phase. This way, the mean force between the coil and the solenoid is constant, while that due to the terrestrial magnetic field is zero. See Figure 5.

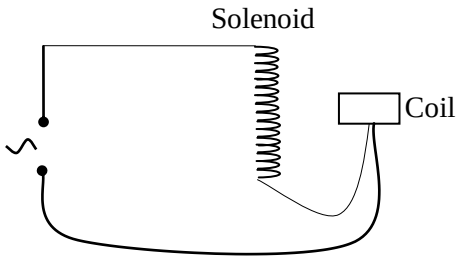

Figure 5

Explanation for the video:

1. The solenoid. The white arrow marks the middle of the solenoid.
2. The length of the solenoid is 195 cm.
3. The rectangular coil of 7 cm × 3 cm is mounted on 2 pivoting contacts.
4. When the coil is near the solenoid, the force on it is strong.
5. When the coil is farther the force is much smaller.
6. Experiment with a bigger coil.

2. Conclusion

This experiment shows that magnetic force on current or electron beam really exists in the middle plane of a long solenoid and explains that Aharonov–Bohm effect is due to this force. Classical electromagnetic theory cannot explain this phenomenon.

3. My other articles on Aharonov–Bohm effect

Aharonov–Bohm effect in CRT experiment PDF, Word with video
Macroscopic Aharonov–Bohm effect experiment and theory, pdf, word
Consequences of macroscopic Aharonov-Bohm effect, Blogspot, word
Non-Lorentzian Magnetic force and Aharonov-Bohm effect in CRT, Blogspot, Word