Solenoid parallel action experiment

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In Q: Parallel action with a solenoid I have asked a question: the magnetic field of a long solenoid being zero, will it make a coil rotate in its plan? This experiment will investigate the parallel action of a long solenoid. I have done this experiment and here is my result.

1. The experiment

This experiment tests the force on a flat and rectangular coil in the magnetic field of a long solenoid. If the coil rotates in its plan, a force parallel to current must exist. For doing so, the free-to-rotate-in-its-plane test coil is mounted on a contact pivot in front of the solenoid's middle. **Figure 1** and **Figure 2** show a drawing and a photograph of the setup.

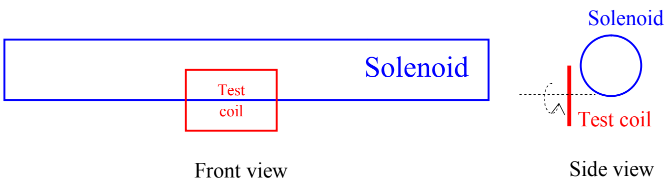

Figure 1

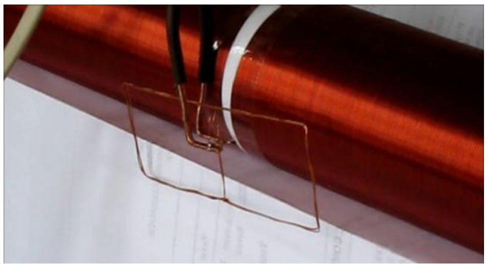

Figure 2

According to classical theory the magnetic field of a long solenoid is zero around its middle and, the test coil should not get force. Secondly, the field lines around the middle of the solenoid being all parallel to the solenoid (see **Figure 3**), the Lorentz force on the current should be perpendicular to the coil's plane (see **Figure 4**) whatever the angle the coil makes with the field lines. These two strong reasons make the test coil impossible to rotate. However, this experiment has shown the contrary.

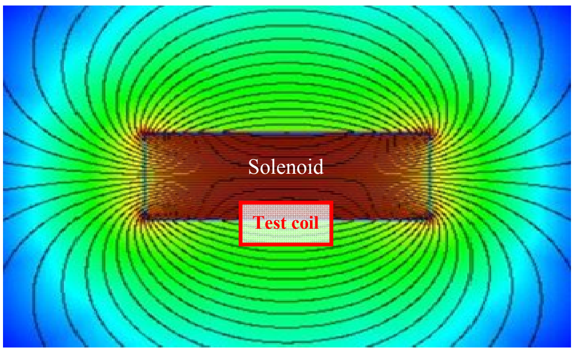

Figure 3

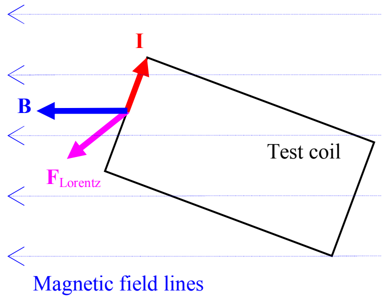

Figure 4

The video of this experiment is on Youtube: https://youtu.be/BO86_5fxda0
Below is the explanation sequence by sequence.

1. *The test coil in front of the solenoid*
   The solenoid is of length 36 cm and diameter 4.3 cm; the white arrow marks its middle.

2. *The test coil is flat and rectangular*
   The coil's dimension is 3 cm × 7 cm with 3 turns.

3. *Position of the coil with respect to the solenoid*

4. *The test coil does not move when it is connected alone.*
   In order to ensure that the movement of the test coil is due to the magnetic field of the solenoid alone, the test coil is connected first without connecting the solenoid. In this case the test coil does not move and we conclude that the environmental magnetic field does not disturb the test.

5. *The Solenoid is connected and the test coil rotates.*
   Then the solenoid is connected. This time the test coil rotates, showing the force exerted by the solenoid. The rotation being parallel to the test coil and field lines (see **Figure 3**), this force is in the plane defined by the vectors ***I*** and ***B*** and thus, is not a Lorentz force (see **Figure 4**).

6. *When test current reverses, rotation reverses.*
   This proves that the rotation is due to the current in the test coil.

7. *Test with a bigger coil*
   This coil's dimension is 6 cm × 11 cm.

8. *When test current reverses, rotation reverses.*
   With different coil in different position the same force is confirmed.

9. *Test with a hairpin wire. No Lorentz force on the leads because they are parallel to the field vector.*
   In addition to the test with coils, a test with a hairpin wire is done. **Figure 5** and **Figure 6** show the drawing and photograph of the setup.

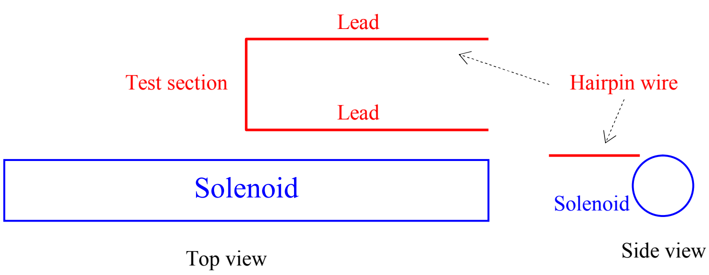

Figure 5

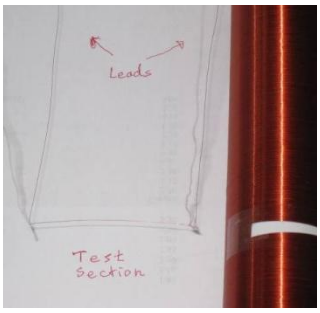

Figure 6

10. *The wire moves parallel to the test section showing a force parallel to its current.*
    The test section is exactly in the middle plane of the solenoid and its movement confirms the existence of parallel-to-current force in the middle plane of the solenoid.

11. *Test with a bar magnet. The coil rotates in opposite direction in apparently identical fields.*
    The magnetic field of a bar magnet is similar but much stronger than that of a solenoid. The field vector is symmetric around the bar magnet and in theory, the force on the test coil should

be the same. But, when the coil moves from left to right without reversing current the rotation reverses.

12. *The coil rotates in opposite direction on opposite sides of the bar magnet*
    In order to explain the similitude of the magnetic fields on the two sides of the bar magnet, let us see **Figure 7** where the test coil is below the bar magnet. The coil A in the right is in the plane A of symmetry, while the coil B in the left is in the plane B. With the same current, the right coil rotates directly, while the left one rotates reversely.

    The bar magnet is round and it stays identical when it is given a rotation of any angle. Let us see **Figure 8** and **Figure 9** where the planes A and B are rotated 45° in opposite direction to become the same plane. In this case, the coils A and B are at the same point in the plane of symmetry and make an angle of 45° or -45° with the latter. As they are symmetric to this plane, magnetic fields around them are exactly the same. But, the forces on them are opposite. In the experiment, the angle is different because of the distance from the solenoid. This test reveals a new strange property of magnetic field unknown to the classical theory.

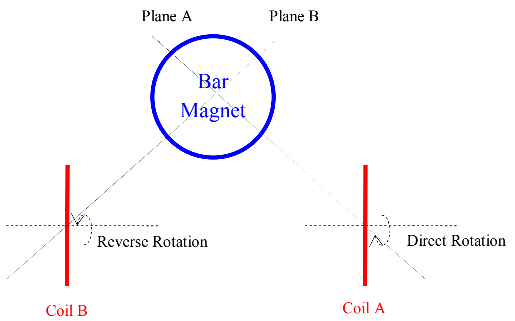

Figure 7

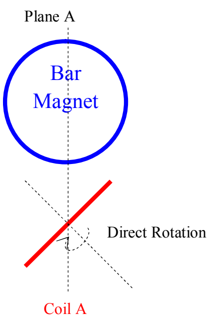

Figure 8

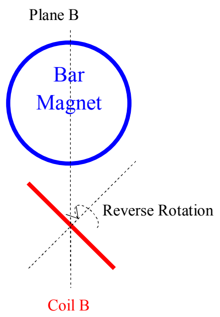

Figure 9

13. *Tangential force motor with the bar magnet*
    With sliding switch the test coil rotates constantly in its plan.

14. *The force propelling the coil is parallel to current*
    This motor is propelled by a non-Lorentzian force.

2. Conclusion

This experiment has shown the existence of a new force which is strange for the following reasons:

1) It is parallel to current: the test coil rotates in the plane defined by the vectors ***I*** and ***B***, the hairpin wire moves parallel to the test section's current.
2) Two magnetic fields of same direction and magnitude exert opposite forces on same current.
3) This force is exerted by a magnetic field that is claimed to be zero by the classical theory.
4) This force shows itself on macroscopic scale while Aharonov–Bohm effect, today's only known action of a solenoid, is on quantum scale.

3. Comments

I have been able to design this experiment and show this strange force thanks to my corrected magnetic force law (see Unknown properties of magnetic force and Lorentz force law). The mechanism of this force is explained in my Theory about parallel action experiment in which the magnetic field is created by a rectangular coil. For a rectangular solenoid the mechanism is the same.

The present experiment unveils a new property of the magnetic field of a solenoid beside Aharonov–Bohm effect for which I have done several experiments and theoretical studies (see Aharonov–Bohm effect in CRT experiment and Consequences of macroscopic Aharonov-Bohm effect).

This new property is extremely interesting because it indicates a whole new world in magnetism that classical electromagnetic theory does not cover. It is essential to rapidly investigate this phenomenon. But the physical community seems slow in accepting imperfection of classical electromagnetism and this new magnetism is hindered in getting known.

So, please repeat my experiments and show your result. You will surprise your professor because he would never believe that questioning the classical theory is possible. More important is that your experimental proof will make things change faster and the first experimenters will be remembered forever for their contribution.