Disc magnet parallel action experiment

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The magnetic field of the earth can rotate a flat coil in its plane. This is explained in Earth's magnetic field and parallel action. Will a disc magnet rotate a flat coil the same way? The magnetic field of a disc magnet is central symmetric and the field lines are contained in median planes (See Figure 1). If a flat coil is coplanar with a median plane, the Lorentz forces on the currents will be perpendicular to the plane of the coil. So, Lorentz force could not rotate the flat coil in its plane. But in my experiment the coil rotates. The video is on Youtube: http://youtu.be/GVTyiyhS2WU

1. Experiment

Here is the explanation of the video.

1. The flat test coil, 9 cm x 9 cm square, 3 turns, with axis of rotation perpendicular to its plane.
2. Will the coil rotate in the magnetic field of the disc magnet?
3. The coil is coplanar with a median plane of the disc magnet.
   See Figure 1
4. When current is connected the coil rotates counter-clockwise in its plane.
5. The currents and the field vectors are all in the coil's plane and the Lorentz forces are perpendicular to the coil's plane.
   See Figure 2

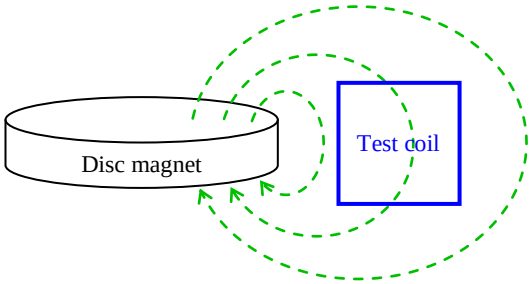
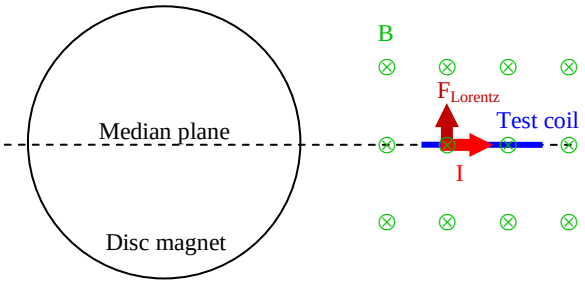


Figure 1



Top view

Figure 2

6. The vertical paper on the disc magnet represents the median plane.
7. The coil is coplanar with the vertical paper, thus with the median plane.
8. On coils oppositely offset from the median plane the Lorentz forces are opposite. Will the coil rotate oppositely?
   See Figure 3.
9. The green and orange strips mark the offset positions.
10. The coil in the median plane rotates counter-clockwise.
11. The downwardly offset coil still rotates counter-clockwise.
12. The upwardly offset coil rotates counter-clockwise again.

Comment for the offset experiment: The offset coils rotate in the same direction in a region around the median plane. So, the tested force is not a Lorentz force which should change direction.

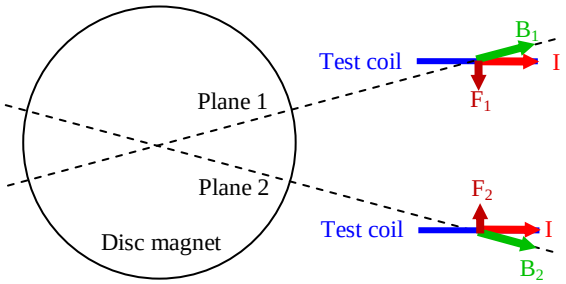


Figure 3

13. Without magnet the coil does not rotate. So, the earth's magnetic field does not disturb the experiment.
14. Is the magnet well centered?
15. The direction of the magnetic field at the center is indicated by the iron pin which is upright.
16. Off center the pin inclines symmetrically.
17. So, the field of the disc magnet is well centered.

Bonus: Lorentz force of the disc magnet on a straight wire

18. The magnet is vertical and the wire is twisted by the edge of the magnet.
19. The magnet is horizontal and the wire is repulsed on one side, sticks to the edge on the other side.

2. Conclusion

Conclusion: When a flat coil is coplanar with a median plane, the Lorentz forces are perpendicular to the coil's plane and cannot rotate the coil. As it still rotates, it is propelled by a non-Lorentz force which has parallel-to-current component. This force has the same direction on oppositely offset coils while Lorentz forces are opposite, confirming its non-Lorentz-force nature.