Name

4 March 2018

Title: Lab Report

**Purpose**

The purpose of the experiment is to determine the horizontal component of the magnetic field of the earth, and to determine the magnetic fields caused by a current carrying solenoid through tracing its path. Thirdly, the purpose was to determine the direction of the magnetic field which surrounds a long straight wire using a pair of compasses.

**Procedure**

The magnetic fielded of the earth emerges from its inner core and becomes horizontal near the earth’s magnetic equator. The earth’s magnetic field can be studied using a Helmholtz coil. In one part of the experiment, a Helmholtz coil was used, which consisted of two similar coils that were separated at the same distance as their radius, and carry the same current. The magnetic field was measured by positioning small compasses between the two coils. It was noticed that the compasses pointed towards our right side, which pointed towards the north-west area, as we passed a current through the coil.

In the wire experiment, a current I was passed along a straight wire generating a magnetic field around it. In theory, the field lines produced by the current form concentric circles that surround the straight wire. The distance away from the wire R, and the current I, determine the magnetic field’s magnitude (B). The direction of the field can be determined through the right-hand rule. The direction in our experiment was measured by placing two compasses in the vicinity of the wire while a current of 12 A was passed through it. We observed the right compass to have the opposite direction of the one we placed at the left, which faced south against the right one, which was pointing North. The value of R was measured to determine the experimental value of earth’s horizontal component.

In the solenoid experiment, the magnetic field should ideally be constant along its length and remain inside the solenoid. It is parallel to the axis of the solenoid. However, in our experiment with a real solenoid, the magnetic field was not observed to be constant at its ends, and some portion of the field was observed outside the solenoid. Compasses were used to determine the direction of the magnetic field that began to curve slightly as they were placed in series.

**Results**

Horizontal Component BE of the Earth’s magnetic field

BE = BW (neutral point)

BW = μ0I /(2πr) = BE ; Where μ0 = 4.0π x 10-7 H/m

**r** measured at 9.2 cm = 9.2 x 10-2 and I = 12A

BE = μ0I /(2πr)

= (4.0π x 10-7 x 12) / ( 2π x 9.2 x 10-2)

= 0.0000150792 / 0.57805

= 2.61 x 10-5 T

= 0.26 μT

BE (Horizontal component) = μ0I /(2π rcosθ) where θ = 550

= 4.5 x 10-5 T or 0.45 μT

BE (theoretical) = 44,100 nT

BE (experimental) = 45,000 nT

Discrepancy = (45000-44,100 / 44,100) x 100%

= 2.041%

**Errors**

In our experiment results, a discrepancy of 2.04% was observed compared to the theoretical value of the magnitude of the earth’s magnetic field. These errors could result from a number of factors, for instance the presence of magnetic fields being produced by other nearby electronic appliances or devices that possibly interfered with the measurement of the magnetic field and affected the value of R on the paper. Moreover, the accuracy and precision of the measurements from the instrument which we used to measure the magnetic field and distance away from the wire, possibly due to random or parallax errors arising from the compass readings while trying to obtain the magnetic field’s direction. Moreover, since the horizontal component was being measured, therefore rounding off could affect the precision of the results. Another possible source of error could be the nature of the wire itself that did not produce a uniform field, along with that the presence of other metal objects may have affected the compasses readings.

**Conclusion**

To conclude, the experiment we performed in the lab to determine the magnitude and direction of the magnetic fields in the case of the long straight wire, and the directions of the field in the case of the solenoid and Helmholtz coil was successful as we were able to understand and observe how the magnetic field of the earth is affected by passing a current. Although the experimental results slightly deviated from the theoretical values, there were various sources of errors that affected our measurements to cause the deviation. However, the experiment was still completed successfully, as we were able to successfully measure and calculate the magnitude and direction of the horizontal component of the magnetic field of the earth.