Experimental General Physics for Engineers II

**Laboratory Report** PHYS 194 summer 2022

Section: \_L01\_\_\_\_

Experiment name: Earth magnetic field

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| Table of results (1.25 pts) |  |
| Graph (1.25 pts) |  |
| Data analysis (2 pts) |  |
| Discussion (0.5 pt) |  |
| References |  |
| Others |  |
| **Report Grade (5 pts)** |  |

1. Geometry of the coil

Radius R of the coil: R=10 ± 0.1 cm

Number of turns n of the coil: n= 10 turns

Permeability of free space: Tm/A

1. Table of Results

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| (A) | u()  (A) |   (°) | u()  (°) |   (rad) | u()  (rad) | (A-1) | u()  (A-1) | cot() | u(cot()) |
| 0.04 | ±0.1 | 4 | ±1 | 0.070 | ±0.017 | 25 | ±625 | 14.30 | ±3.59 |
| 0.05 | ±0.1 | 5 | ±1 | 0.087 | ±0.017 | 20 | ±400 | 11.43 | ±2.30 |
| 0.06 | ±0.1 | 6 | ±1 | 0.104 | ±0.017 | 16.67 | ±277.8 | 9.51 | ±1.59 |
| 0.07 | ±0.1 | 7 | ±1 | 0.122 | ±0.017 | 14.28 | ±204 | 8.14 | ±1.17 |
| 0.08 | ±0.1 | 8 | ±1 | 0.140 | ±0.017 | 12.5 | ±156.2 | 7.12 | ±0.90 |

1. Graph of cot() vs.

Plot cot() vs in Excel

1. Data analysis
   1. Uncertainties on and cot()

Show how you calculate u () and u (cot ())

U(I)= ±0.1 A U ()= ±1 degree = ± pi /180 radian = ±0.017 rad

U(1/I) = sqrt ((d(1/I)/d(I) \* U(I))2) = sqrt ((-1/I2) \* U(I))2) = sqrt ((0.1/0.042)2) = **±62.5 (A-1)**

U (cot ()) = sqrt ((d (cot ())/d () \* U ())2) = sqrt ((-csc2() \*U ())2)

= sqrt ((-csc2(0.0) \*pi/180)2) = **±3.58**

* 1. Slope, intercept of the graph and their uncertainties

Give the values of the slope intercept and their uncertainties

**Slope =** 0.574779 A

**U(Slope) =** ±0.000217 A

**Intercept =** -0.06715

**U(Intercept) =** ±0.003961

* 1. Value of the horizontal component of the earth’s magnetic field Bh

Calculate Bh based on the value of the slope of the graph and the geometry of the coil

cot () = Bh/A \* 1/I slope = Bh/A

A=µ0n/2R is constant, A= 6.28 x 10-5 ((Tm/A)/m)

Bh = slope \* A = 0.575 \* 6.28 x 10-5 = **3.61 x 10-5 T**

* 1. Uncertainty on Bh.

Calculate u(Bh) based on the value of the slope of the graph and the geometry of the coil. I.e. take u(R) into account in the calculation.

U(Bh) = sqrt((d(slope)\*1.257x10-5/2R)/d(slope)\*U(Slope))2+((d(slope)\*1.257x10-5/2R)/d(R)\*U(R))2)

= sqrt ((1.257 x 10-5 /2R \* 0.0002)2+((0.575\*1.257x10-5/2R2 \* 0.001)2)

= sqrt ((1.257 x 10-8)2+(3.61 x 10-7)2)

= **±3.6 x 10-7 T**

* 1. Comparison with the accepted value.

Compare your results to the commonly accepted value of Bh. ­­in Doha.

| (Theoretical value – obtained value)/theoretical value | \* 100

= | (3.37 x 10-5 – 3.61 x 105)/3.37 x 105 | \* 100 = **7.16%**

1. Discussion of the result

The results in agreement with what is expected with small margin of error. With a value error percentage 7.16% different from the actual value of Bh.

Sources of error can be due to human error and inaccuracy while observing the data and while measuring the angle.

The experiment was successful with an error percentage 7.16%

1. References