PHYF214 PHYSICS LAB REPORT SEM1 2018-2019
Lab 9 Group 7: Magnetic field of Helmholtz Coils [HC]

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1 Experimental Tasks

1. To study the variation of the magnetic field along the axis of a current carrying circular loop.
2. To study the variation of the radial (B_r) and axial (B_z) components of magnetic field due to a single current carrying coil. The field measurement are to be done in a plane at a distance R/2 from the plane of the coil.
3. To study the axial and radial components of a pair of coils in Helmholtz configuration, both along the axis of the coils (r = 0) and in the plane midway between the planes of the coils (z = 0).
4. To determine the magnetic field of the Earth inside the lab using the coils and the compass.

2 Apparatus

Pair of Helmholtz coils Power supply, Digital multimeter , Teslameter, Hall probe, Meter scale, Barrel base, Right angle clamp, Connecting wire.

3 Theory

4 Observations

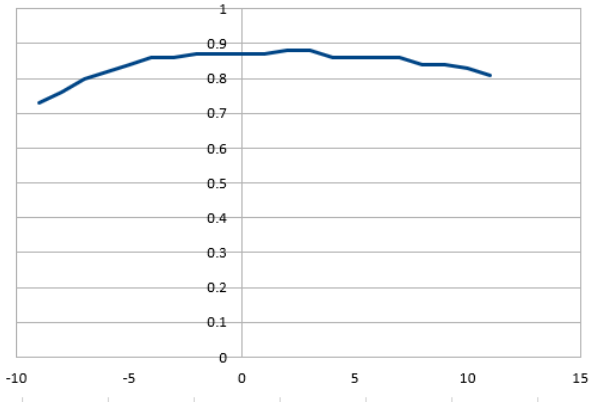
Least count of the Hall probe is 0.01 mT.
Inner diameter of the coil is 37cm.
inner radius of the Helmholtz coil is 18.5cm.

4.1 *Trial 1: B_z as a function of z for a=R and I=1.25A*

Table 1: Data for trial 1

position(cm)	relative position (in cm)	B(in mT)
30	-9	0.73
29	-8	0.76
28	-7	0.8
27	-6	0.82
26	-5	0.84
25	-4	0.86
24	-3	0.86
23	-2	0.87
22	-1	0.87
21	0	0.87
20	1	0.87
19	2	0.88
18	3	0.88
17	4	0.86
16	5	0.86
15	6	0.86
14	7	0.86
13	8	0.84
12	9	0.84
11	10	0.83
10	11	0.81

Figure 1: Graph of B vs Position for trial 1



4.2 *Trial 2: B_z as a function of z for a=R/2 and I=1.3A*

Table 2: Data for trial 2

position	relative position	B(in mT)
29	-11	0.87
28	-10	0.89
27	-9	0.93
26	-8	0.94
25	-7	0.96
24	-6	1
23	-5	1.03
22	-4	1.05
21	-3	1.07
20	-2	1.09
19	-1	1.11
18	0	1.11
17	1	1.12
16	2	1.09
15	3	1.07
14	4	1.06
13	5	1.03
12	6	1.02
11	7	0.99
10	8	0.95
9	9	0.93
8	10	0.9
7	11	0.84
6	12	0.79

4.3 *Trial 3: B_z as a function of z for a=2R and I=2.10A,*

(Table and graph appended at the end)

4.4 *Trial 4: B_z as a function of z for Right Coil Short Circuit*

(Table and graph appended at the end)

4.5 *Trial 5: B_z as a function of z for Left Coil Short Circuit*

(Table and graph appended at the end)

Figure 2: Graph of B vs Position for trial 2

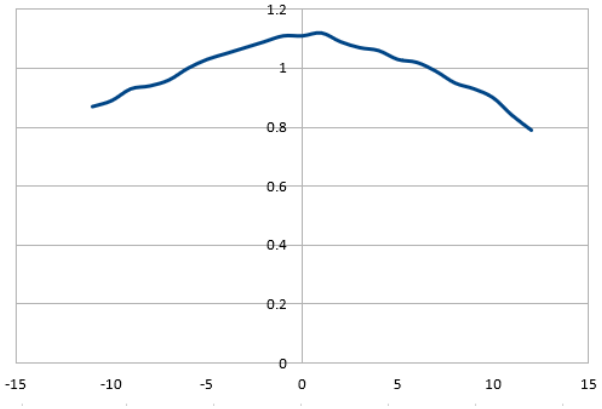


Figure 3: Graph of B vs Position for trial 3

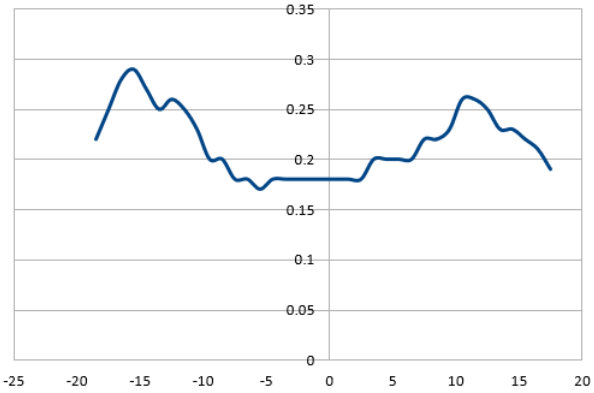


Figure 4: Graph of B vs Position for trial 4

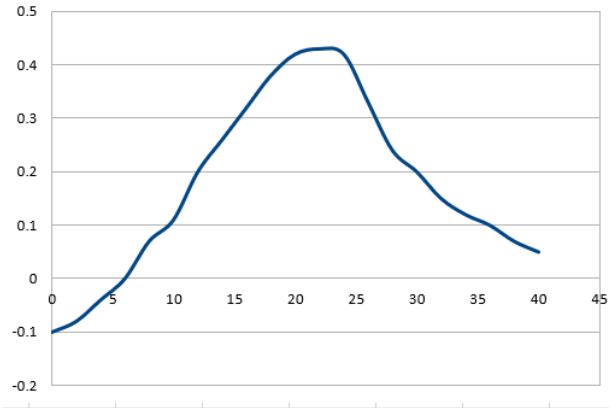


Table 3: Data for trial 3

position(cm)	relative positioin(cm)	B(in mT)
55	-18.5	0.22
54	-17.5	0.25
53	-16.5	0.28
52	-15.5	0.29
51	-14.5	0.27
50	-13.5	0.25
49	-12.5	0.26
48	-11.5	0.25
47	-10.5	0.23
46	-9.5	0.2
45	-8.5	0.2
44	-7.5	0.18
43	-6.5	0.18
42	-5.5	0.17
41	-4.5	0.18
40	-3.5	0.18
39	-2.5	0.18
38	-1.5	0.18
37	-0.5	0.18
36	0.5	0.18
35	1.5	0.18
34	2.5	0.18
33	3.5	0.2
32	4.5	0.2
31	5.5	0.2
30	6.5	0.2
29	7.5	0.22
28	8.5	0.22
27	9.5	0.23
26	10.5	0.26
25	11.5	0.26
24	12.5	0.25
23	13.5	0.23
22	14.5	0.23
21	15.5	0.22
20	16.5	0.21
19	17.5	0.19

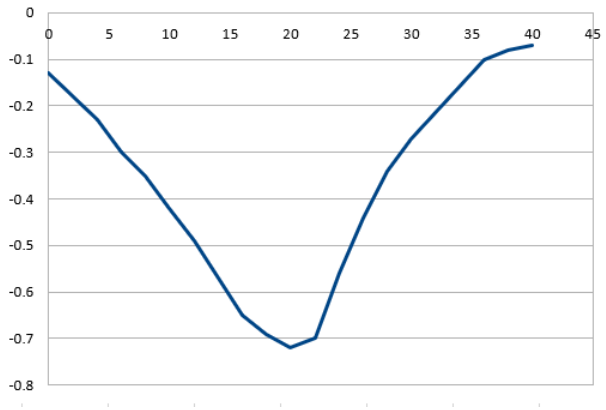
5 Precautions

- 1. Always push the barrel base bearing the Hall probe along the rule in the same direction.

Table 4: Data for trial 4

relative position	B (mT)
0	-0.1
2	-0.08
4	-0.04
6	0
8	0.07
10	0.11
12	0.2
14	0.26
16	0.32
18	0.38
20	0.42
22	0.43
24	0.42
26	0.33
28	0.24
30	0.2
32	0.15
34	0.12
36	0.1
38	0.07
40	0.05

Figure 5: Graph of B vs Position for trial 5



- 3. Connect the probe correctly.
- 2. Check if the connections are correct and if the current in both coils is in the same direction.

Table 5: Data for trial 4

Left Coil Short Circuit	
relative position	B (mT)
0	-0.13
2	-0.18
4	-0.23
6	-0.3
8	-0.35
10	-0.42
12	-0.49
14	-0.57
16	-0.65
18	-0.69
20	-0.72
22	-0.7
24	-0.56
26	-0.44
28	-0.34
30	-0.27
36	-0.1
38	-0.08
40	-0.07

6 *Analysis:*

Magnetic field at a distance z from the center of the coil, along its axis, $dH = (1/4)(Idlxr)/|R^2 + z^2|^3$ Thus when z = 0, flux density has a maximum value when $\alpha < R$ and a minimum value when $\alpha > R$. The curves plotted from our measurements also show this ; when $\alpha =$ R, the field is virtually uniform in the range (-R/2,R/2).