

Lab 10: Earth's Magnetic Field

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1. Record the initial dip angle $\theta_0 = 36^\circ$
2. Set source to 4V.

Table 1: Earth's Measurement of Magnetic Field						
Resistance	20 Ω	40 Ω	75 Ω	150 Ω	180 Ω	200 Ω
Current i	0.122A	0.0733A	0.0442A	0.0256A	0.0212A	0.0182A
Dip Angle Θ_i	-71°	-49°	-14°	6°	12°	15°
Calculated B_i	1.44e-4	8.65e-5	5.22e-5	3.02e-5	2.50e-5	2.15e-5
$\tan(\theta_i)$	-2.90	-1.15	-0.25	0.11	0.21	0.27

3. Record the Helmholtz coil radius: $R = 9.75\text{cm} \rightarrow 0.0975\text{m}$
4. Record the Helmholtz coil number of turns: $N = 128$
5. Calculations: ($B_i = \frac{8N\mu_0 I_i}{R\sqrt{125}}$, where $\mu_0 = 4\pi \times 10^{-7}\text{Tm/A}$, $\tan(36^\circ) = \frac{B_H}{B_V} = 0.727$)
 - Plot $\tan\theta_i$ vs B_i with straight line. Deduce the values of B_V and B_H from the graph.
 - $B_V = B_E \cdot \cos(\theta_0) \rightarrow B_E \cdot \cos(36^\circ) = 0.809\text{T}$
 - $B_H = B_E \cdot \sin(\theta_0) \rightarrow B_E \cdot \sin(36^\circ) = 0.588\text{T}$
 - Calculate $B_E = \frac{B_H}{\sin(36^\circ)} \rightarrow \frac{0.588}{\sin(36^\circ)} = 1.0004\text{T}$
 - Lookup value of $B_E = \frac{3.02\text{e-}5}{0.11 - 0.727} = -4.89 \times 10^{-5}\text{T}$
 - $\text{Slope} = \frac{1}{-4.89 \times 10^{-5}\text{T}} \rightarrow -2.04 \times 10^4\text{T}$

Graph

$\tan(\theta_i)$ vs B_i

