PHY 4210-01 Senior Lab
Lab M-1: Magnetic Field Mapping

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Abstract

Contents

1 Objective of the Experiment

During this lab, a 3-dimensional mapping of the magnetic field inside a Helmholtz coil was created in order to investigate the presence of a uniform field, running along the axial direction of the Helmholtz coil.

2 Theory of the Experiment

Recall for a straight current-carrying wire, circular magnetic field lines are generated around the wire in accordance with the curling right-hand rule. The Helmholtz coil contains two regions of circularly wound wires. Due to the the circular symmetry, all components of each infinitesimal segment of the wire will cancel *except* for that in the axial direction. In summary, a circular current produces a linear magnetic field.

3 Equipment Utilized

A DC Gaussmeter (AlphaLab Model GM-1-HS) was connected to a Hall Effect Probe in order to measure the field strength inside the Helmholtz coil. The Hall Effect Probe contains a semiconductor junction that, when exposed to a magnetic field, produces a voltage proportional to the field strength.

The position of the Hall Effect Probe can be modified in the ρ direction by sliding the ruler bar through the acrylic cube shown in figure **??**. The position can be modified in the ϕ direction by rotation the ruler bar about the central pole. However, for the sake of this experiment, this did not have to be modified because measurements were taken in a single ρ, z plane. The z coordinate was modified by sliding the acrylic cube and ruler bar up and down the central pole.

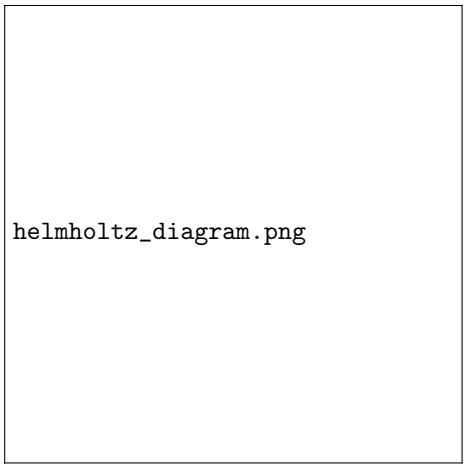

Figure 1: Two concentric Helmholtz coils seperated by a distance equal to their radius. Rotating pole and sliding ruler allow for modification of the probe's position.

4 Procedure

Note that, per suggestion of the laboratory manual, the procedural steps of this experiment have been omitted. The discussion section provides sufficient detail on what actions were taken.

4.1 Data Analysis

5 Results

6 Conclusion