

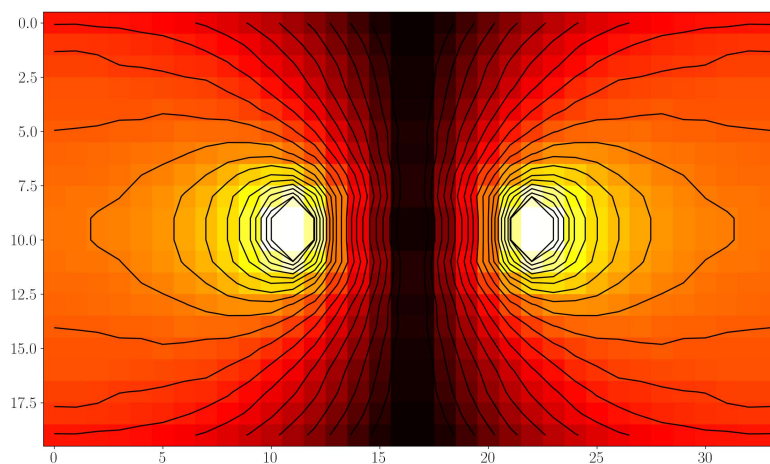
Conductivity in Less than Three Dimensions: Determining the Width of Graphite Slabs and Resistivity of Various Materials

QiLin Xue

(Dated: December 1, 2022)

In this experiment, we determined the thicknesses and electrical resistivities of two concrete slabs using an electrical approach. Additionally, we also determined the electrical resistivity of aluminum foil by analyzing the electrical properties of an aluminum sheet and also of an aluminum strip. All electrical measurements were done with four-point measurements using an injected current of $I = 1 \pm 0.05$ A.

Furthermore, we also sampled 170 points on one of the graphite slabs (pg 4) to confirm that we get the expected potential plot, which is shown below. Notice the “squishing” of equipotential lines near the center and the “stretching” of lines towards the extreme ends.



A Wenner array was used to measure the resistivity of the graphite slabs (pg 3), and the results are on page 17 and 18. We found that for the slabs labelled #1 and #2, the depths were 3.45 ± 0.05 cm and 2.14 ± 0.03 cm respectively. Their respective resistivities are $(7.1 \pm 0.9) \times 10^{-5} \Omega\text{m}$ and $(1.16 \pm 0.08) \times 10^{-5} \Omega\text{m}$ respectively. According to literature, graphite, depending on its purity can have a resistivity of $3 - 60 \times 10^{-5} \Omega\text{m}$ ^[1].

Measurements on both the aluminum thin sheet and the aluminum thin strip were performed using a Schlumberger array (data: pg 10, 11 — results: pg 20, 22) and the resistivity was measured to be $(8.2 \pm 0.6) \times 10^{-8} \Omega\text{m}$ for the sheet and $(3.6 \pm 0.1) \times 10^{-8} \Omega\text{m}$ for the strip. Literature shows that aluminum has a resistivity of $2.76 \times 10^{-8} \Omega\text{m}$, which has the same order of magnitude and is only 30% off from our strip measurement. The reason it is very far off from the sheet measurement could be because of edge effects becoming dominant due to current sources being close to the boundary.

[1] Table of Resistivity — hyperphysics.phy-astr.gsu.edu. <http://hyperphysics.phy-astr.gsu.edu/hbase/Tables/rstiv.html>. [Accessed 02-Dec-2022].