CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
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Project Number
S0915

Project Title
Optimal Levitation Height Based on the Placement of a Neodymium Magnet on a YBCO Superconductor

Abstract

Objectives/Goals
The purpose of this research project was to determine if placing a neodymium magnet (Nd2Fe14B) on a certain location, or quadrant of a Yttrium barium copper oxide superconductor would result in the very differential yielded heights of levitation while levitating using the Meissner Effect of Superconductivity.

Methods/Materials
To obtain the magnet and superconductor, a Colorado Superconductor Inc. Kit was used. Four quadrants were drawn onto the superconductor and the center of it was marked also. An apparatus consisting of an area for the superconductor and liquid nitrogen to be placed for the initial levitation was designed and created from a simple Styrofoam box and a bowl, the bowl had a hole in the side that allowed a green laser that was attached to the box pass its beam through and take advantage of the liquid nitrogen vapor, resulting in a illuminating green beam. This allowed one to simply take pictures of each conducted trial and then use ImageJ # an image analysis program from the National Institutes of Health, to calibrate the pixel to millimeter ratio and find accurate and precise data. Images were taken from an angle, and from the top (to validate the levitation). Using ImageJ the levitation Height of each magnet can be found by subtracting the distance from superconductor to the bottom of the laser beam by the mean of the distance of the magnet from the beam. The following equation was formed: Levitation height = D # B(m).

Results
Every trial conducted made it blatantly obvious to the naked eye that quadrant three of the superconductor demonstrated the lowest levitation heights 100% of the time. There was no trial were any quadrant levitated lower than quadrant three. There was an average deviation of 1.5, and the percent deviation was 14.2%, due to the fact that quadrant three and the center had such a large difference. In reality the deviation would be much lower; however each trial received a deviation, not each quadrant because it would be very difficult to calculate with a square shape magnet.

Conclusions/Discussion
The center levitated the highest 100% of the time, this ongoing trend suggests that the closer the magnet is placed towards the center, the greater the levitation height. This is perhaps due to the fact that the center has the greatest amount of excluded fields, and thus the greatest levitation heights.

Summary Statement
Finding the best placement on a superconductor for the highest levitation height.

Help Received
Professor Debra Mauzy-Melitz provided a lab at UCI to work in