CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Julienne Sauer

Project Number

33581

Project Title

Quantum Locking: The Future of Frictionless Motion

Abstract

Objectives/Goals

The purpose of this research project is to compare the various properties of superconductors with respect to how much weight they can hold when levitating in a magnetic field. The properties tested were the area of the superconducting disk (1/2" and 1" diameter), the type of superconducting material (YBCO, BSCCO), and levitation technique (Meissner Effect versus Quantum Locking).

Methods/Materials

Yttrium barium copper oxide (YBCO) and Bismuth strontium calcium copper oxide (BSCCO) superconductor disks were immersed in liquid nitrogen, cooled below their critical temperatures, and then suspended in a magnetic field. Weight was added to the top of each disk until it could no longer levitate and then they were weighed. It was hypothesized that if various types and sizes of superconductors are suspended in a magnetic field, then the BSCCO superconductor disk with the largest area will hold significantly more weight. And if different types of levitation techniques are tested, then the superconductor that undergoes Quantum locking will hold significantly more weight.

Results

When comparing superconductor area, both the YBCO and BSCCO 1" diameter disks held the most weight. When comparing the two different types of superconducting material, it was found that BSCCO holds more weight than YBCO. Finally, when comparing YBCO and BSCCO disks with an Enhanced Flux Pinning (EFP) YBCO superconducting disk, it was found that the EFP disk held more weight showing that Quantum locking is a better alternative for levitation than just the Meissner effect. A one-tailed paired t-test was used to determine whether the average weight held was statistically significant for each of the tested superconductors. The obtained p-values between all data distributions were less than the assigned alpha value of 0.05. This shows that the 1" diameter BSCCO disk held significantly more weight than the other disks, and that the Quantum locked disk held significantly more weight than the disks experiencing only the Meissner effect. This supports the research hypotheses and rejects the null hypotheses.

Conclusions/Discussion

This research concludes that Quantum locking is a better alternative for levitation of superconductors than just the Meissner effect. Quantum locking has the potential to revolutionize many applications in transportation, energy conservation, space travel, and eventually can be used to design frictionless bearings.

Summary Statement

This project investigates whether Quantum locking is a better alternative for levitation of superconductors than just the Meissner effect .

Help Received

Parents supervised liquid nitrogen use.