CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY

Name(s)
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Project Number
J0906

Project Title
Optimal Coil/Core Geometry for Electromagnetic Accelerators

Abstract

Objectives/Goals
This experiment tested the relationship between coil and core length to achieve maximum velocity for electromagnetic accelerator applications.

Methods/Materials
Force as a function of core position in the coil was characterized by transferring the force on the core to a scale using a wooden plunger. Velocity was calculated from the measured force by approximating the acceleration to be piecewise constant by averaging each pair of adjacent data points. The tests were conducted for three coil lengths and a range of core lengths. Total wire length for each coil was held nearly identical, as was the resulting coil resistance, and therefore current in the coil.

Results
Overall, the longest core in the longest coil reached the highest calculated velocity of 98 m/s under the assumptions of zero friction and instantaneous current shut off. In the case of the shortest coil, the longest core also produced highest calculated velocity, but velocity vs. core length appeared to be at or near the maximum.

Conclusions/Discussion
However, for a fixed core length, the data set shows that the optimum coil length is a factor of 1.3 shorter than the core. This relationship will be used to design a multi-stage electromagnetic accelerator.

Summary Statement
The purpose of my project was to find the optimal coil/core ratio to maximize velocity in an electromagnetic accelerator.

Help Received
My father helped me use the drill press and the hand drill I used in this project and he explained to me how to derive velocity from acceleration. My mother helped me in the assembly of my board.