CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY

Name(s)

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Project Number

22532

Project Title

The Effects of a Magnetic Field on the Paths of Alpha Radiation Particles

Abstract

Objectives/Goals

My objective is to experimentally find a mathematical expression to model the relationship between magnetic field and radius of an alpha particle under the influence of a magnetic field. An alpha particle in a magnetic field perpendicular to its velocity will move in a circular pattern. I wished to find an equation to describe this pattern. The final equation should be in the form Radius (m) = k (Tm) * v (m/s) / B (T), where R is radius, k is a constant, v is velocity, and B is magnetic field strength.

Methods/Materials

I first set up a diffusion cloud chamber with isopropyl alcohol and dry ice. Then I connected the power supply to 3 resistors in parallel. The circuit was connected to a solenoid around the cloud chamber vertically. Current flow created a magnetic field, which could be measured using the CBL System with the Magnetic Field Sensor. Aerial pictures were taken of alpha particle trails from a Uranium Ore source placed in the center of the chamber. I selected 5 pictures with different degrees of magnetic field and a 6th picture with 0 magnetic field (control). I selected 4 points from every path analyzed. Using inverse matrices I was able to construct a polynomial of degree 3 to model the curve. Then, through differential methods I was able to find a suitable radius to describe the curve. Using algebra, an equation in the form of R = k /B was found. By extracting the velocity of an average U3O8 particle, an equation in the form of R = k * v / B can be found.

Results

Radius is inversely proportional to field and directly proportional to velocity.
Average experimental constant (k) = 0.2900 Tesla meters
Radius = 0.2900 Tm / Magnetic Field
Radius = 2.049 * 10^-8 kg/C * v / B

Conclusions/Discussion

Experimental error was around 5% (from the ideal equation radius = mv/qB). The process used to analyze the curves could be refined to improve accuracy. The inverse relationship between magnetic field and radius was proven. Extraction of velocity was found by using the velocity of an average U3O8 particle. Using my procedure, testing of many other characterstics of particles can be done. Further testing may include using the setup to experimentally test for the mass, charge, velocity, etc. of an unknown particle.

Summary Statement

How the strength of a magnetic field affects how much the path of an alpha particle curves.

Help Received

Father gave suggestions; Used equipment at University High School under supervision of Mr. Robert Ferazzi and Mr. Glenn Malin

Preliminary