CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY

Name(s)

Faizan Ahmed; Andrew Hsu; Benjamin Hsu

Project Number

S1501

Project Title

The Polarization of Electrons Based on the Spatial Quantization of Quantum Spin

Abstract

Objectives/Goals

Will electrons subsequently curve based on their respective spatial orientations.

Methods/Materials

An electron gun and a magnet had to first be obtained. Once this was done, some solenoids had to be created to generate the magnetic field (½ Tesla) necessary to split the beam of electrons.

At first, only one set (2 solenoids) were used and the resulting beam was observed. Next, the filters had to be created.

Since the CRT was narrow, the undesired beam was easily bent into the side of the CRT, eliminating the undesired electrons. However, here the experiment differed slightly with the original plan. Instead of filtering out #down# electrons, #up# electrons were filtered out.

Once the initial testing was done, the first filter was tested at 30°, 45°, 60°, 90°, and 180° from the transmission axis. The resulting beam was noted per rotation. When the first filter was complete, the second filter was applied, and after that, the third filter was applied, each time, the filters were rotated through the same five angles. The third filter was treated slightly different: for each angle that allowed an electron beam through in the second filter, the third filter was rotated through its five angle set, allowing the third filter to test its polarization effect on a resultant beam.

Results

With the first filter, all five angles of rotation produced an electron beam. When second filter was rotated from 0° to 90°, an electron beam was able to pass through, but with a rotation of 180°, none traveled through either filters. Each angle between 0° and 180° had a gradual decrease in the intensity of the electron beam that faded to zero as the transmission axis differed. During the light polarization, an angle of 90° produced zero transmission while an angle of 180° produced a transmitted beam.

For the third filter, the angles in the second filter that allowed an electron beam through, electrons were able to makeit through the third filter. However, when the third filter was rotated 180°, relative to the first the orientation, a beam of electrons emerged.

Conclusions/Discussion

In conclusion, the experiment was a success. Using solenoids, it was possible to polarize a beam of electrons into two separate beams. By testing multiple orientations of the magnetic field, certain quantum mechanical effects were observed such as correlation and the Heisenberg Uncertainty Principle.

Summary Statement

The Effect of Various Orientations of Spin Filters on the Spatial Quantization of Electrons

Help Received