# CALIFORNIA STATE SCIENCE FAIR
## 2003 PROJECT SUMMARY

**Name(s)**

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**Project Number**

**S1501**

**Project Title**

# The Effect of a Magnetic Field on the Spectral Lines of Hydrogen

**Abstract**

**Objectives/Goals**

The objective of the project is to utilize a magnetic field in order to discover any disparities between spectral lines. According to the quantum theory, electrons surrounding the nucleus of atoms have a magnetic field, precisely a magnetic dipole, because of an electron's intrinsic spin and angular momentum. If a uniform magnetic field is applied to a hydrogen atom, then the single electron's magnetic field can manifest only in specific alignments causing displacements in energy.

**Methods/Materials**

Samples of Hydrogen gas were obtained in tube form and a device to electrify the "hydrogen bulb" so that a spectral analysis of hydrogen could be made. A homemade solenoid "an electromagnet" was created out of a .3048 meter (1 ft) steel pipe and 28 AWG magnet wire. Then, a varying power supply that was capable of creating up to 6A of current was used in order to power the solenoid to create a magnetic field with strength up to 2 Tesla. The diffraction grating for hydrogen sample was taken, acting like a "super prism" by separating the colors of light much more than a regular prism's dispersion effect as well as pictures that captured the spectra. The data collected from the diffraction grating of the hydrogen sample without the magnetic field served as the control group. The experimental group, made up of another sample of hydrogen gas, was introduced to a magnetic field. The diffraction grating of the hydrogen sample under the magnetic field was taken, and the separation of spectral lines of the hydrogen sample was noticed via photography equipment.

**Results**

When the uniform magnetic field was not applied on the hydrogen sample, the diffraction grating of the control Hydrogen sample showed a single spectral line from the n =3 to n =2 transition. However, the experimental sample's diffraction grating split from a single spectral line into three distinct spectral lines, because of the displacement(s) of energy caused by the magnetic field.

**Conclusions/Discussion**

Through the use of a uniform magnetic field, the magnetic moment of electrons was shown to affect the spectral lines of atomic transitions. The displacement of energy levels in the closely spaced spectral lines of hydrogen is formed because the electron, under the uniform magnetic field, may assume only certain alignments and releases the energy through different wavelengths.

**Summary Statement**

The use of a uniform magnetic field to split a spectral line of hydrogen into other closely spaced spectral lines defined by the magnetic field associated with an electron's magnetic moment.

**Help Received**

Used power supply from Telemetrics