CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Maliha S. Ahmed

Project Number
S1901

Project Title
The Effect of a Magnetic Field and Applied Voltage on the Rotation of a Fluid Induced by a Lorentz Body Force

Abstract

Objectives/Goals
The main concept in MHD is the interplay between an electric field and magnetic field. Both act on a moving conductive fluid and cause it to rotate by creating an creating a Lorents force on this fluid. My project studied the effect of this force (via velocity), as an electric current was passed through a conducting fluid in the presence of a magnetic field. The independent variable was voltage, which was varied by using different batteries pre-set to different voltages. The dependent variable measured in the experiment was velocity. Different magnets were experimented with, including neodymium-iron-boron magnets and ceramic magnets. My hypothesis was that as voltage increased, velocity would increase as well.

Methods/Materials
Two electrodes were constructed by wrapping aluminum foil on the inside of a petri dish (outer electrode) and by rolling aluminum foil into a tight cylinder which was placed in the center of the dish (inner electrode.) The arrangement of magnets was placed underneath this dish, to keep magnetic field perpendicular to the current flow/drift velocity. From a strong conducting electrolyte solution (NaCl) to a weak conducting one (CuSO4 solution), 15 ml of each were measured for experimentation using a graduated cylinder.

Conclusions/Discussion
Overall, the trend seen in the experimental values was consistent with the calculated values. Calculated values were mathematically derived from the Lorentz force law. By using a weakly conducting solution, I was able to preserve laminar flow which is essential in the study of MHD. This interesting phenomenon has a wide array of applications that occur in various settings from Earth's fluid core to microfluid devices implemented in biology laboratories utilizing polymerase chain reaction protocols.

Summary Statement
My project investigated the effects of a magnetic field and voltage on magnetohydrodynamics to further understanding of the unique phenomenon.

Help Received
Mother, help with board; Mrs. Gabriela Scully, help with physics; brother, help with mathematical derivation; Bakersfield College professors, help with concepts and proper experimentation

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Aley Barnum; Courtney Bishop

Project Number
S1902

Project Title
Marco Polo: A Study of Interaural Time Delay and Amplitude Perception

Abstract

Objectives/Goals
To determine if when the time delay and volume of sound reaching the ears is changed, then the perception of the source of the sound will change.

Methods/Materials
Two microphones were set 10 cm apart on anechoic foam. In test A, a beeping sound was played every fifteen degrees on a semicircle with a one foot radius around the mics. In test B, the beeps were played every six inches in a direct line from the mics. The recorded sound waves were converted into graphs on a computer, which compared the left mic to the right mic.

Results
The amplitude and time delay differed when the origin of the sound changed.Test A supported that time delay can be used reliably to perceive the direction of a sound's source. However, test B did not support volume as a directional source clue because there was no pattern to which mic had a greater amplitude.

Conclusions/Discussion
Sound perception (on headphones exclusively) can be accurately manipulated in a few steps:
1.Make an exact copy of the track (track A and track B)
2.Decide what direction you want the sound to come from
3.Find the appropriate time delay
4.Play track A in one ear, wait the time delay, then play track B in the other.

Summary Statement
This project is a study of how sound is perceived and how to accurately manipulate its perception.

Help Received
Erik Barnum helped create computer program.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Peter K. Blanchard

Project Number

S1903

Project Title

A Photometric Study of Eclipsing Binary Stars: A Methodology for Classification

Abstract

Objectives/Goals

This project was a study of two W Ursae Majoris eclipsing binary star systems, AB Andromedae and ER Orionis. The study sought to describe the stars based on various classification schemes and to verify classifications found in the literature.

Methods/Materials

Operating a telescope in New Mexico, observations of these two systems were made and measured by photometry software. Lightcurves were created from these observations and modeling software was used to fit models to the observational data. From these models, certain parameters of the binary star systems were determined and compared with those found by other research.

Results

It was found that inferences made from observations by the author were mostly in agreement with known parameters and classifications. AB Andromedae and ER Orionis are systems where the stars are in contact and therefore fill or even overflow their Roche lobes. The stars' spectral classes range from G to F, which are stars with temperatures ranging from about 5000 to 7500 Kelvin.

Conclusions/Discussion

It was verified that AB Andromedae and ER Orionis are W Ursae Majoris eclipsing binary star systems. This project was successful in understanding the morphologies of these two systems and will continue to gather data for other stars. This project developed an efficient way to classify eclipsing binary stars demonstrating the value of amateur astronomical data.

Summary Statement

This project developed a methodology for the classification of eclipsing binary stars.

Help Received

Help received from Raja Guhathakurta, Professor of Astronomy at UCSC.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Mark D. Canning

Project Number
S1904

Project Title
A Study of the Effect of the Curvature of Spacetime on the Speed of a Graviton as Perceived by an Outside Observer

Abstract

Objectives/Goals
This project was designed to test the theory of the Graviton, the theorized elementary particle predicted by the standard model of physics that mediates the force of gravity. The theory would be tested by measuring the speed that gravitational force propagates, and seeing if gravitational time dilation occurs, which would support the theory of the graviton.

Methods/Materials
A PC equipped with Microsoft Excel and Maple 7 was used. Data was taken from the NASA JPL HORIZONS ephemeris. The position vector, velocity, and light-time were retrieved from the ephemeris. The sets varied in time span and interval between points. The vectors of gravitational acceleration acting on the Earth due to each object were determined, and summed. The Earth#s acceleration vector and a vector of the rate of change in the acceleration of the Earth were calculated. A value equal to the light-time would provide support for the hypothesis, a value equal to the distance to the sun divided by c would provide support against my hypothesis. Any other value would be inconclusive.

Results
The first set of data showed the average time delay to be 1.77E+3 seconds, and had a standard deviation of 2.68E+5 seconds. The second set of data showed the average time delay to be 8.18E+3 seconds and had a standard deviation of 2.42E+6 seconds. The third set of data showed the average time delay to be 1.07E+5 seconds and had a standard deviation of 2.11E+6 seconds. The fourth set of data showed the average time delay to be -4.87E+3 seconds and had a standard deviation of 1.32E+6 seconds.

Conclusions/Discussion
Overall, the total data was inconclusive for support of my hypothesis. All four sets of data had too high of a statistical uncertainty to provide clear evidence. The largest cause of error was likely due to the lack of knowledge of the Earth#s instantaneous acceleration and rate of change of acceleration. Further research suggests that, while gravity is not likely to propagate at the speed of light, the gravitational field of the solar system is not changing, making the propagation speed of gravity appear to be infinite to any experiment of this nature. In a further experiment testing this hypothesis it would be necessary to either measure the values for systems that are rapidly losing mass, or to measure the speed of gravitational waves.

Summary Statement
To study the effect of the curvature of spacetime on the observed speed of a graviton.

Help Received
Father proofread reports.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Adira L. Dooley

Project Number
S1905

Project Title
Sta-Netic

Abstract

Objectives/Goals
My project was to compare the differences between the static and kinetic friction that act upon different objects when they slide down a sheet of glass. I believed that the watch would have the greatest difference because it is very textured and is made of rubber.

Methods/Materials
Materials: Cell phone, Watch, Pillow, Notebook, Shoe, Protractor, Sheet of glass, Triple beam balance

In my experiment, I increased the angle of the sheet of glass while the object was on it. Then, once the object began moving, I recorded the angle and calculated the static friction. To calculate the kinetic friction, I observed the angle at which the object moved continuously down the sheet of glass.

Results
I observed that the watch had the greatest difference, with 0.521, the notebook had the next, with 0.235, the pillow was next, with 0.185, then the cell phone, with 0.171, and the shoe had the least difference, with 0.009.

Conclusions/Discussion
I concluded that my hypothesis was correct, the watch had the greatest difference between the two frictions. But, my results differed from what would have been expected. In all cases, the kinetic friction was greater than the static, and all of my background research said that the static friction is always greater than kinetic. I plan to do further research and try to fix whatever error I may have made.

Summary Statement
My purpose was to compare differences between static and kinetic friction acting on different objects.

Help Received
Physics teacher helped come up with procedure; Environmental science teacher helped revise procedure; Father helped record data and format board.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Nitin K. Egbert

Project Number
S1906

Project Title
Relativistic Stress: A Phantom Force Emerging from the Interaction between Matter and Curved Space

Abstract

Objectives/Goals
My project explores the effects of a phenomenon which emerges from the interaction of matter with curved space. My postulate is that rigid materials resist changes in the curvature of space, and the goal of this project was to prove that.

Methods/Materials
A potential energy proof of this phenomenon is fairly straightforward. Materials that are moved from one region of space to a differently curved region of space have to contort. It requires energy to contort materials, and since some of the energy put into moving the material into curved space must go into contorting it, it follows that the material will resist moving to a region of differently curved space.

Results
For a material falling toward some gravitating body (like a planet), it is simple to calculate the amount of force with which the material will resist movement by comparing the potential energy gained in contortion to the potential energy lost in falling toward the planet, since any system will try to minimize potential energy. Unfortunately, the effect is not very visible under low curvatures of space. To float a triangle above the earth, it would have to be made at least 30 orders of magnitude more rigid than ordinary materials. However, simulation shows that under special circumstances, this effect is of an observable magnitude.

Conclusions/Discussion
If there is some efficient way to employ this effect, it has many applications. The most obvious one is in space travel: using this effect may dramatically reduce the cost of launching something into orbit. There are many ways to test this effect, the simplest of which is dropping two materials of different rigidity and measuring the difference in acceleration. The most practical means of demonstrating the effect with current technology is to fill an ultracentrifuge with a rigid material. Due to the high apparent curvature of space in an ultracentrifuge, it will take more energy to spin a rigid material than a malleable material in the centrifuge.

Summary Statement
My project is about the fact that rigid materials should resist changes in the curvature of space.

Help Received
Bounced ideas off my father.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Alexandra I. File

Project Number
S1907

Project Title
Effects of Rotational Inertia on a Fastball

Abstract

Objectives/Goals
The goal of this project was to see what effects rotational inertia would have on the velocity of a softball pitched fastball. Another goal of the project was that by finding the results of the experiment to use the data to help younger pitchers understand more about pitching. I myself also learned a lot which was very helpful in the end. By slowly spreading the mass of the pitcher farther and farther away from their axis of rotation, the results of this project were found.

Methods/Materials
The method is this project was that pitchers from within my county would pitch five fastballs. The five pitches were a regular fastball, fastball finishing with their left arm out, fastball finishing with their right arm out, fastball finishing with their hip back, and fastball finishing doing all three of the above (left, right, hip.) A radar gun was placed behind them and at the end of each pitch the velocity was recorded. Materials used for this project were quite simple, a softball, a radar gun, a pitching area, and a pitcher.

Results
The results showed that the farther away mass was from the pitcher's axis of rotation the slower the resulting velocity would be. The left arm, and doing all three of the finishes proved to result in the slowest velocity. This was because in these two pitches the mass was farthest from the axis of rotation.

Conclusions/Discussion
The hypothesis was proven correct through this experiment. It was proven that the farther away a pitcher's mass is from their axis of rotation their resulting velocity will be much slower than if they finish tightly with all their mass closer to their axis of rotation. There were not many surprises that were encountered in the conducting of this experiment, and the results turned out very good and helpful.

Summary Statement
The idea of my project was to see what effects rotational inertia would have on the velocity of a softball pitched fastball.

Help Received
Radar gun provided by my pitching coach

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Eric M. Fischer

Project Number
S1908

Project Title
Mechanical Exfoliation and Characterization of Graphene via Raman Spectroscopy

Abstract

Objectives/Goals
Graphene, a one-atom-thick planar sheet of carbon atoms arranged in a honeycomb crystal lattice, has the ideal properties to be an excellent component of integrated circuits, but must be mechanically exfoliated onto a substrate and characterized using Raman spectroscopy prior to any implementation into future devices. By reliably identifying certain mechanically exfoliated graphene samples as single layer or bilayer, the samples can be utilized in the fabrication of novel quantum devices.

Methods/Materials
To mechanically exfoliate graphene onto a silicon dioxide substrate, layers of graphite were cleaved onto the full length of a piece of tape, which was then applied to a substrate and removed slowly to maximize graphite/graphene deposition. A raster scan was performed with an optical microscope to find graphene flakes, and pictures were taken to record the location of the graphene flakes. Graphene flakes were then characterized with a Renishaw Ramascope.

Results
The full width at half-maximum of the single layer suspect sample was recorded to be 24.3 cm-1, confirming it was indeed single layer graphene. The full width at half-maximum of the bilayer suspect sample was recorded to be 50.9 cm-1, confirming it was indeed bilayer graphene. The full width at half-maximum of the multilayer suspect sample was recorded to be 69.7 cm-1, confirming it was indeed multilayer graphene.

Conclusions/Discussion
The photon-phonon interactions during Raman spectroscopy resulted in energy shifts (in units of cm-1 of the photons from the laser) that can be used as #fingerprints# for the particular material investigated. Characterized graphene samples can now be used to engineer new devices in nanotechnology, such as graphene-based transistors. Carbon electronics will hopefully become the successor to silicon electronics and the solution to Moore#s law, which has predicted a bottleneck effect for the continued scaling of transistors.

Summary Statement
Analyzing Raman spectrum plots of graphene samples after creating said samples through the mechanical exfoliation process is vital for the future implementation of graphene in novel quantum devices.

Help Received
Used lab equipment at UCLA thanks to Professor Kang L. Wang. Mentor was Carlos Manuel Torres Jr, a graduate student in the Henry Samueli School of Engineering.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Wyatt C. Gormley

Project Number
S1909

Project Title
Reflections on Reflection

Abstract

Objectives/Goals
The purpose of this year#s science project, Reflections on Reflection, was to attempt to develop a cost effective method of concentrating light onto a photovoltaic solar panel. Specifically, we tested which reflective materials work well and by how much it improves efficiency. As a result of the low accuracy of the hyperbolic and smaller parabolic reflector, only the large parabolic reflector was used. Our tests include one thirty minute and five ten minute trials with and without using the large parabolic reflector.

Methods/Materials
The procedure included constructing a Cassegrain reflector using mirror tape and window mirror film, and allowing a photovoltaic solar panel to charge three AA Ni-MH batteries for sets of 10 and 30 minutes with and without the use of the reflector. After the charging period, the cumulative voltage of the batteries was tested and were connected to six LED lights; this duration was recorded. Five sets of ten minutes and one set of thirty minutes were conducted.

Results
The data supported the idea that such a device can enhance the power of a photovoltaic cell. In the ten minute period, the batteries charged with the reflector lit the LEDs for 46 minutes, while the batteries charged without the reflector lit the LEDs for an average of 15 minutes. This shows that using the reflector tripled the charge stored in the batteries under a given time. Ultimately, voltage did not serve well as a means of measuring how much more energy was absorbed.

Conclusions/Discussion
This experiment produced applicable information that may possibly influence the solar panel industry by providing less expensive CPV solar units. Finding ways to produce an affordable means of manifesting solar light is the major struggle the solar companies face; by continuing and expanding upon experiments like this the use of solar energy will help to win the fight for energy independence.

Summary Statement
Reflections on Reflections is an exploration of concentrate photovolatics, by constructing a modified Cassegrain reflector.

Help Received
Parents funded; internet aided with research

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Dylan E. Moore

Project Number
S1910

Project Title
A Photoelectrochemical Cell to Obtain Hydrogen from Water with Visible Light

Abstract

Objectives/Goals
The present demand for energy is growing and fossil fuels are not a sustainable energy source. Emissions from fossil fuels significantly degrade air quality and the greenhouse gasses they release are a leading factor in global warming. Direct solar energy has not proven reliable enough to replace fossil fuels because the sun is not always out. Solar produced hydrogen is a sustainable, storable, green energy solution. Light from the sun can provide the energy needed to separate water into hydrogen and oxygen. The purpose of this project was to build a photoelectrochemical (PEC) cell that uses visible light, dye sensitized TiO(2) and Fe(2)O(3) to convert water into hydrogen and oxygen and to demonstrate how PEC cells could be utilized as an alternative energy resource. This design was a modified Gratzel cell made with readily accessible materials.

Methods/Materials
A two chambered PEC cell was built with acrylic plastic. Nanocrystalline TiO(2) was dye sensitized with anthocyanin obtained from blackberries. Dye sensitized TiO(2) and Fe(2)O(3) were bonded to conductive glass plates and placed in chambers filled with distilled water and electrolyte solution respectively. A platinum wire was inserted into the distilled water and connected to the other chamber. The PEC cell was exposed to light; voltage, electric current and water displacement were recorded at set time intervals. The process was modified and repeated seven times.

Results
Trial 1 and 2 showed no current or hydrogen bubbles. With a stronger electrolyte solution, trial 3 gave a measurement of 0.01mA and several bubbles after 2 hours. In trial 7, with added oxide surface areas and a boost of 12 volts for 2 hours, the reading of the PEC cell was 2mA. The bubbles produced by the cell displaced 1ml of water. It was demonstrated that this gas contained hydrogen by igniting it with a flame.

Conclusions/Discussion
Voltage generated by this particular PEC cell was not great enough to separate useful amounts of hydrogen but larger oxide plates would increase hydrogen production. PEC cells could be used in combination with standard solar cells to provide additional voltage to the process. When placed on rooftops or grouped in solar farms, PEC cells could help replace carbon fuels with economical hydrogen.

Summary Statement
This project demonstrated that anthocyanin dye sensitized titanium dioxide could be employed in a photoelectrochemical cell with hematite and platinum wire to separate water into hydrogen and oxygen using visible light.

Help Received
I did all my research and experiments at home with my parent's supervision.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Tejas A. Navaratna

Project Number

S1911

Project Title

A Dying Star: The Effects of the Post-Main Sequence Sun on the Biological Sustainability of Various Solar System Objects

Abstract

Objectives/Goals

This study was conducted with the primary objective of determining which Solar System object(s) would be most viable during various stages of stellar evolution. Another goal of the research was analyzing the procedure to gauge feasibility in extrasolar planetary research.

Methods/Materials

The objects selected have evidence pointing toward the surface existence of presently frozen or liquid organic compounds or water [Wong, Rivkin, Morrison].Using the Evolve ZAMS software, the raw outputs of solar luminosities were used to calculate equilibrium temperatures on selected objects in the following manner: The temperature variable in the Stefan-Boltzmann equation was solved given the object's albedo, radius, and semimajor axis length [Zeilik]. From this, the ability of the surface substances to be gravitationally bound to the object was determined using statistical analysis of the RMS speed when compared to the escape velocity on the object.

Results

Temperature: Pre-helium flash, Triton will have a temperature of 255K and Enceladus, 203K. Post-helium flash, Io will have a temperature of 304K, Europa, 296K, Ganymede, 339K, and Titan, 272K. When the sun is a developed asymptotic branch giant (AGB), Triton will have a temperature of 260K, and Enceladus, 208K. Atmospheric composition: No gases can exist on Triton or Enceladus prior to the helium flash. Molecular nitrogen, molecular oxygen and carbon dioxide can exist on all the Jovian moons with viable temperatures, and Titan, just after the helium flash. No gases can exist on Triton or Enceladus when the Sun is an AGB star.

Conclusions/Discussion

This research can be interpreted in a multitude of ways, depending on the needs of humanity in the future. If water is a priority, Enceladus would be the best option, as its surface composition in the pre-helium flash and AGB stages indicate. If viable temperatures were of greater importance, Triton would be the better option. Post-helium flash, either Europa or Titan with water on the former and organic compounds on the latter, would be the best options for continued survival. Secondary objective: as the equilibrium temperature estimates for all the objects at present closely (<10%) approximate the actual temperature, the same method can be extrapolated to other planetary systems. This has major implications for astrobiology research as the field of potential objects can be narrowed down for more focused study.

Summary Statement

This study is about the effects of the latter stages of the sun on the Solar System and how the same methods used have applications in other planetary systems.

Help Received

I used the Evolve ZAMS program provided by Dr. Bill Paxton at UC Santa Barbara.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Anh T. Nguyen

Project Number
S1912

Project Title
A Semiclassical Method to Predict Helium-like Energy Levels

Abstract

Objectives/Goals
The objective of my project is to develop a modified Bohr#s model using a semi-classical approach (using the Bohr theory and Coulomb repulsion energy) that can be easily understood by any high school students with simple geometry and pre-calculus math level to predict the energy levels and emission spectra of Helium-like atoms (ex: Helium and Lithium+1).

Methods/Materials
For materials, I used a spectrometer, a diffraction grating, and gas discharge tubes to measure the emission spectra lines. I also used the NIST database to get the energy levels for Helium-like atoms. Use my method to predict the emission lines and the energy levels, and then compare it to experimental lines and real energy levels from NIST database.

Results
The calculated energy levels of Helium and Lithium+1 was found surprisingly close to the NIST database. As for the spectral lines, the calculated and the experimental result was a little off. This is due to the fact that my method is based on Bohr's model, which did not include elements of Quantum Mechanics: the 2nd quantum number, spins of electrons, possibilities of transitions...etc.

Conclusions/Discussion
Because my model is simple (based on Bohr model, without Quantum Mechanics elements), it can be used to predict a approximate value of energy levels and spectral lines of Helium-like atoms, but not the exact value. This can be used as a tool for any high-school student with pre-calculus math level to predict energy levels, spectral lines, and somewhat have an understanding of Helium-like atoms without dealing with Quantum Mechanics which require Calculus-level math skills.

Summary Statement
I propose a semi-classical model to predict energy levels and spectral lines of Helium-like atoms.

Help Received
I work in my school's lab and used the school's equipments. My friends helped me finish the board, and Dr.Kuiper provided me important information and advice for my project.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

William F. Paja

Project Number

S1913

Project Title

Solar Cells: Berries vs. Leaves

Abstract

Objectives/Goals

The objective of the project is to determine if dye-sensitized solar cells that implement berry pigments absorb more solar energy than dye-sensitized solar cells that implement leaf pigments.

Methods/Materials

Eight dye-sensitized solar cells were made, two implementing raspberry pigments, two implementing blueberry pigments, two implementing blackberries, and two solar cells implementing lemon leaf pigments.The solar dye-sensitized solar cells were put under fluorescent lights for ten minutes allowing solar absorption for three trials. The solar cells were tested for voltage by using a multimeter. The amount of voltage obtained by the berry solar cells were compared to the amount of voltage obtained by the leaf solar cells.

Results

The berry solar cells obtained a higher individual and average amount of obtained voltage than the leaf solar cells. The average amount of voltage obtained by all the dye-sensitized solar cells that implemented berry pigments was 0.401 volts while the dye-sensitized solar cells that implemented berry pigments obtained an average of 0.258 volts.

Conclusions/Discussion

The berry pigments performed better in the solar cells for different reasons. For instance, the berry dye containing anthocyanins reacted well with electrolyte injection and titanium dioxide. Furthermore, the leaf pigments, specifically chlorophyll, die off quickly, need to be produced often in a plant, and are designed to have less absorption ability due to the fact that they cover the majority of the surface area of most plants. In addition, the pigment structures of anthocyanins, the berry pigments, absorb more photons and the blue-green and green light of the spectrum. This means the pigments reflect the red end of the spectrum, resulting in a higher intensity of absorption. The data shows that dye-sensitized solar cells that implement berry pigments absorb more solar energy than dye-sensitized solar cells that implement leaf pigments.

Summary Statement

Dye-sensitized solar cells implementing berry pigments and leaf pigments were made and tested under fluorescent lights, resulting in the conclusion that the berry solar cells obtained more solar energy than those that used leaf pigments.

Help Received

My aunt helped me obtain nanocrystalline titanium-dioxide and laboratory materials; Mother and Aunt supervised me; Father bought berries.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Shubha S. Raghvendra

Project Number
S1914

Project Title
"Indian Restaurant" or "Interstate": An Analysis of Voice Frequency across Ethnic Identities

Abstract

Objectives/Goals
Why do voice recognition systems (VRS's) often misinterpret words of foreign-born English speakers-even without an accent? Is there a physical distinction between the sounds native- & foreign-born English speakers speak, maybe a distinctive #frequency signature#?
Hypothesis:People of different ethnicities speaking the same English words produce physically different output waves with distinct frequency signatures dependent on their geographical location.

Methods/Materials
1.Get sound clips of foreign language speakers(FLS) speaking an English paragraph-mine were from George Mason Universitys linguistics database.
2.Organize these sound files into a database categorized by the location (continents) of the FLS & by the time the speaker has lived in an English-speaking country (less than 1/2 of life, more than 1/2 of life). Choose a specific phoneme to focus the study on (as VRS's break down words similarly).
3. Use FFT algorithm, examining frequency, to analyze data. Using SpectraPLUS software, run the sound samples through the spectrogram plot and cut the spectrogram output down until it includes only the phoneme focused on.Repeat step 3 for all sound files.
4.Organize the outputs into a display (placing them side-by-side) in order to: a.Phase1: Compare speakers with others from their own region, b.Phase2: Compare Phase1 speakers with long-term emigrants to English-speaking countries., c.Phase3: Compare long-term emigrants from Phase2 to native English speakers.

Results
-There is indeed a distinct physical difference in the English words of speakers from around the world, with similarities seen in clusters dependent on geographical location.
-With more exposure to native-born English speakers in English-speaking countries, the frequency signature of most foreign-language speakers shifted to the frequency signature of English spoken by native speakers(ESNS). Lower frequencies shifted as much as 60 Hz down to the standard ESNS threshold;higher frequencies shifted up as much as 800 Hz up to the standard ESNS threshold.

Conclusions/Discussion
The implications of my study are that current VRS's are ineffective because of the range of frequencies they analyze may not be the same as users'.I surmised that a possible solution to the issue of a VRS programmed only to detect certain frequency intervals could be to create a dial that could be turned to tell the VRS by how much to bias the frequencies.

Summary Statement
My study maps the geographical locations of English speakers (both first & and second language) to the physical characteristics of the sounds they speak, specifically frequency.

Help Received
Father helped me with statistical analysis; Mother helped with presentation board.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Abhejit Rajagopal

Project Number
S1915

Project Title
Selective Isolation and Manipulation of Single-Walled Carbon Nanotubes using AFM Lithography

Abstract

Objectives/Goals
The goal of this project is to determine a general set of parameters for moving, manipulating, and cutting single-walled carbon nanotubes with and without a charged tip that can be used on a world-wide scale as a standard for nanochip fabricators.

Methods/Materials
Materials:
- Pacific Nanotechnology Atomic Force Microscope
- Pacific Nanotechnology Standard AFM tip and Charged AFM tip
- Dell 2350 computer
- Silicon dioxide plated chip with electrodes and nanotube growth (94-S)

1.Obtain a sample with abundant carbon nanotube growth (AKB 94-S)
2.Place sample onto puck and into AFM (Pacific Nanotechnology), calibrate, and image a particular tube.
3.Open the LPM software (Pacific Nanotechnology) and collect image from AFM, enter scan settings and start lithography.
4.Verify cut using the AFM data.

Results
It was practically impossible to consistently move around SW CNT's. This can be explained by the complex nature of both Columbic and Van der Waals forces acting on the nanotubes and the AFM tip acting on an atomic level. However, efficient parameters were established for cutting tubes at different scan rates, set points, and tip voltages. With no tip voltage, a quadratic relation was discovered between the scan rate and set point. With tip voltage, a direct relation was observed.

Conclusions/Discussion
It was observed that SW carbon nanotubes were cut by an uncharged AFM tip at a lower set point voltage when the scan rate was small, around 4 µm/s. As the scan rate increased, the required set point also increase, as expected because a larger force would have to be present to cut the tube originating from the moving AFM tip. However, an interesting outcome that was overlooked in the begging was discovered; as the scan rate becomes very small, below 4 µm/s, the required set point voltage to cut the nanotube increases. This can be explained by the fact that very slow scan rates will tend to 'push' the tube rather than cut it, as well as the friction and stickiness of the tube.

Summary Statement
This project provides a general set of parameters for moving, manipulating, and cutting SW CNTs with and without a charged tip that can be used on a world-wide scale as a standard for nanochip fabricators.

Help Received
Worked in lab at University of California at Irvine (UCI) under Prof. Phil Collins, mentored by grad student Steven Hunt

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Morris Sarafian

Project Number
S1916

Project Title
Tricky Curie

Abstract

Objectives/Goals
A magnet's magnetic field is affected by a change in temperature. My hypothesis for this project was that the magnet with the lowest Curie point would be affected by temperature the greatest. For this project, I used neodymium, samarium-cobalt, and alnico magnets, different size beakers, dry ice, ice, BBs, and boiling water to test my hypothesis.

Methods/Materials
Materials: 3 Neodymium magnets; 3 Samarium-cobalt magnets; 3 Alnico magnets; Beakers(2 200 mL beakers, 2 100 mL beakers, 1 400 mL beakers); Thermometer ; BBs; Dry ice; Ice; Boiling water.

Procedures:
1. Obtained neodymium magnets
2. Put them in a beaker
3. Put dry ice in a large beaker and put the beaker of magnets into the dry ice beaker
4. Kept magnet beaker in the larger beaker until the magnets have reached -79 0 C
5. Took out magnets and put them into beaker full of BBs
6. Counted number of BBs attracted by each magnet
7. Repeated process for ice, boiling water, and room temperature.
8. Kept set of magnets at room temperature
9. Put the magnets into a beaker full of BBs (control)
10. Averaged the data
11. Repeated process for samarium-cobalt and alnico magnets
12. Averaged Data
13. Graphed Data
14. Analyzed Data
15. Found type of magnet that is affected by temperature the greatest.

Results
For this project, I tested the three different magnet types at four different temperatures. After doing the tests, the results showed that the magnet with the lowest Curie point was affected the greatest by the temperature changes. The magnet with the lowest Curie point was the neodymium magnet out of the three magnets tested.

Conclusions/Discussion

Summary Statement
My project was to determine which magnet type would be affected the greatest by the temperature changes.

Help Received
Some of the equipment was supplied by the school

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Shannon E. Willard

Project Number
S1917

Project Title
Detecting the Coriolis Effect in a Hose

Abstract

Objectives/Goals
The objective is to determine if the Coriolis effect can be detected by its influence on water flowing through a coiled hose in a rotating frame of reference.

Methods/Materials
Trials were conducted with a 30 meter hose coiled in a clockwise direction and with it coiled in a counterclockwise direction. For each configuration, it was put in three frames of reference: rotating clockwise, rotating counterclockwise, and stationary. Water was siphoned through the hose, with siphon head consistent for all trials, for 810 seconds for each combination of coil direction and frame of reference. The amount of water siphoned during the 810 seconds was used to calculate the siphon rate and evaluate its dependence on the interaction between coil direction and rotating frame of reference.

Results
When the rotation was such that the Coriolis force was in the direction to accelerate the water in the same direction as the hose was coiled, the siphon rate increased by approximately 8.7% over the no rotation case. When the Coriolis force was in the opposing direction, the siphon rate decreased by about 4.6% from the no rotation case. Results were consistent for both hose coil directions.

Conclusions/Discussion
The Coriolis effect is one of the most important factors affecting weather on Earth. However, most phenomena affected by the Coriolis effect from Earth#s rotation are on a scale of kilometers, making measurement difficult on a small scale. This experiment showed that by greatly increasing the rate of rotation of the frame of reference, the Coriolis effect can be significant on a much smaller scale. It was shown that under these conditions, the Coriolis effect can increase the flow of water through a coiled hose as it steers the water in the direction of the hose.

Summary Statement
This project evaluates if the Coriolis effect can be detected by its influence on water flowing through a coiled hose in a rotating frame of reference.

Help Received
My dad helped with the set-up, measurement and analysis.