CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Faizan Ahmed; Andrew Hsu; Andy Reese

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

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Mina R. Bionta

Project Number
S1502

Project Title
Is Sunlight as Dangerous as Laser Light?

Abstract

Objectives/Goals
My objective was to determine if sunlight is as dangerous to the human eye as laser light.

Methods/Materials
I used a lens that is similar to that of the human eye, it has a diameter of 12mm and a focal length of. The pupil diameter was simulated by using a precision iris that changed the aperture. I used a class IIIa laser pointer. Using a photodiode power meter, I compared the power delivered to the focal point at different iris apertures for the laser and the sun.

Results
At an aperture of 2mm, the aperture that the human eye would be when looking at the sun, the sun and the laser deliver the same amount of power to the human eye retina. At apertures greater than this, the sun delivered more power but the power delivered by the laser pointer stayed the same.

Conclusions/Discussion
Sunlight and laser light are equally dangerous to the human eye since they deliver the same power level when collected by a 2mm aperture. The human eye can shrink no smaller than this. Bigger apertures can collect more sunlight since sunlight falls uniformly on the day-lit surface of the earth. This is why the sun delivers more power with the bigger apertures. The laser pointer's spot size had a diameter of about 2mm, so the power level stayed the same for bigger apertures since no more light was being collected. I also compared my laser to different classes of lasers including the world's biggest laser National Ignition Facility (NIF) in LLNL. This laser is far more dangerous than the class IIIa laser pointer that I used in terms of total energy delivered in a short amount of time.

Summary Statement
By measuring power levels at the focus point of a lens similar to the human eye, my project shows the sun can deliver more power than the average laser pointer.

Help Received
Mrs. Susan Edgar-Lee supported entering the project in the Regional Science Fair. Mr. Richard Combs lent me equipment. My parents supervised experiment and proofread my report.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Alan N. Calfee

Project Number
S1503

Project Title
Determining the Characteristics of the Eclipsing Binary Star System V508 Ophiuchi through Observational Astrometry

Abstract

Objectives/Goals
This project in its present form is the complete quantitative analysis of the eclipsing binary star system V508 Ophiuchus. The characteristics of the system were determined by means of observational astrometry, including the processes of spectroscopy, differential photometry, celestial mechanics, and comparative analysis.

Methods/Materials
Using spectroscopy, the tangential velocities were determined by the Doppler shift in the Hydrogen emission lines of the individual stars. The tangential velocity of the primary star is 119 km/s and of the secondary star is 229 km/s.
Differential photometry is the precise measurement of the brightness of celestial objects relative to comparison and check objects. This technique was used to create a light curve, a plot of the stars intrinsic luminosity versus time, of which the orbital period of the system is the period of the light curve, 1.0082 x 10-3 years.

Results
The laws of celestial mechanics and the comparison of these individual stars to similar stars in the Hertzsprung-Russel diagram were used to determine the quantitative characteristics of both the individual stars and of the total system.

Conclusions/Discussion
Binary stars are useful to astronomers in that their mass can be directly determined, the intrinsic luminosity calculated, and the distance from the earth estimated. Knowledge of the distance to the system allows astronomers to estimate the distance to other stars in its vicinity. The study of binary stars has been essential to the development of stellar evolution theory.

Summary Statement
I used a telescope to observe the periodic change in brightness caused by one star eclipsing another.

Help Received
Dr. Anthony Shoup, an associate research physicist of the University of California, Irvine provided access and scheduled time on the UCI observatory.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Ved Chirayath

Project Number
S1504

Project Title
Photometric Detection of an Extra-Solar Planetary Transit across the Sun-Like Star HD 209548

Abstract

Objectives/Goals

I report photometric measurements of HD 209458, an extra-solar planetary system known to have an orbiting planetoid of Jupiter mass by radial velocity measurements. The star has been observed with a 10" Meade Schmidt-Newtonian LXD 55 telescope and imaged by a thermo-electrically cooled Nikon Coolpix 995 CCD digital camera. I detect two full transits at projected transit times defined by radial velocity measurements (Mazeh et al.). An accuracy of +/- 0.01 stellar magnitudes has been achieved using the equipment described. The photometric dimming observed, attributed to the transit of a planet across the stellar disk, is consistent with past photometric measurements made by considerably large observatories (Hubble, Keck I) and provides one of the first small aperture extra-solar planetary detections to date. The primary data analysis procedure used in the determination of stellar magnitude is differential aperture photometry. Also presented are derived values for the diameter of the extra-solar planetary disk.

Methods/Materials

Procedures -

1. Position telescope to track star HD 209458 solar system.
2. With CCD camera, take picture of three stars next to HD 209458 solar system and HD 209458 system, itself, every 2 minutes.
3. Apply differential photometric analysis of star field, so that any changes in luminosity of the HD 209458 system will be genuine and not artifacts of atmosphere (where other stars in the pictures will be used to show HD 209458's luminosity fluctuation is unique among all other stars apparent in picture.)
4. Using light curve measurements, determine planet's properties.
5. Monitor light curve to check for abnormalities unique to extra-solar planets.

Conclusions/Discussion

The hypothesis was supported by detailed differential aperture photometric analysis of HD 209458. An accuracy of +/- 0.01 stellar magnitudes was achieved, and was sufficient enough to discern the light curve of the extra-solar planetary system. Based upon light curve measurements, I report the radius of the planetoid orbiting HD 209458 to be 1.3 Jup. , a .2 difference from radius derived by radial velocity measurements by Keck I (Marzeh et al 2000). This proves consistent with past photometric measurements by Charbonneau et al. 2000. Consequently, these photoelectric measurements confirm a planetoid of 1.3 Jup. , orbiting around HD 209458.

Summary Statement

Detecting and estimating the size of a planet orbiting a sun-like star outside our solar system.

Help Received

Equipment and software donated by USC under supervision of Dr. Hans Bozler. Mother helped procure telescope. Father helped on Observation trips.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Collin N. Cronkite-Ratcliff

Project Number
S1505

Project Title
Time Flies When You're Having Fun Making a Long Story Short

Abstract

Objectives/Goals
The objective of this project is to measure two effects predicted in Einstein's special theory of relativity: time dilation, in which a clock moving at a speed close to that of light will be observed to "slow down"; and length contraction, in which a meter stick moving at the same speed will be observed to shorten in length. The scaling factor for these effects is predicted to be gamma, equal to the inverse of the square root of 1 - beta squared, where beta is the ratio of the moving object's velocity to the speed of light. These effects are measured using relativistic particles created in high-energy particle collisions.

Methods/Materials
The experiment described here involves rapidly moving radioactive particles known as K-shorts (Ks0). K-shorts are produced in high-energy collisions. In this experiment, the average lifetime of the particle was used as the "ticking" of the clock while the decay distance provides the relative length scale. The K-short particles used in this experiment were produced in 90 GeV (billion electron volts) e+e- collisions at the Stanford Linear Accelerator Center (SLAC) and observed in a very large collider detector (SLD) surrounding the interaction region.

Results
K-short particles emerge from the interaction region with a wide range of speeds up to 0.9997 times the speed of light. The ticking of the clock and the decay length are measured as a function of the velocity of these particles. Time is observed to slow down and length is seen to contract by up to a factor of about fifty. These measured results are compared with those predicted by Einstein's special theory.

Conclusions/Discussion
Time intervals are shown to expand by the factor gamma, while length intervals are shown to contract by gamma, over a very wide range of gamma. The measured effects agree well with those predicted by Einstein's special theory.

Summary Statement
This experiment uses radioactive particles produced in high-energy particle collisions at the Stanford Linear Accelerator Center (SLAC) to measure the relativistic effects of time dilation and length contraction.

Help Received
Members of the SLD experiment provided me with the data and taught me about the spectrometer and data analysis; in particular, Dr. David Muller and Dr. Ken Baird helped me in accessing the data and Dr. Blair Ratcliff taught me about the data analysis.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Kelly Eaton

Project Number
S1506

Project Title
Oil Intrusion: How Temperature Affects Diffusion

Abstract

Objectives/Goals
I investigated the relationship between diffusion in water and water temperature, with application to the spreading damage of an oil slick in open ocean. I hypothesize that diffusion rate will increase in direct proportion to absolute temperature.

Methods/Materials
To quantify the measurement of diffusion, I used a droplet of concentrated sodium chloride (salt) solution as the solute rather than crude oil. Since a salt molecule separates into electrically charged ions when dissolved in water, the electrical conductivity between a pair of electrodes can be used to detect when the droplet has diffused to the region between the electrodes. De-ionized (DI) water is used as the solvent rather than ocean water. The experiment is repeated through a range of temperatures of the water solvent to discover the relationship between diffusion and temperature.

Results
Over the experimental 20 - 90 Celsius range, diffusion was observed to increase approximately exponentially with temperature rather than linearly as was hypothesized.

Conclusions/Discussion
Because temperature increases the diffusion rate, a warm-water oil spill is potentially more troublesome than a cold-water spill. Oil spills in warm waters spread faster than I predicted, and therefore can result in more serious environmental consequences over a larger area.

Summary Statement
I experimentally determined the relationship between water temperature and diffusion with application to the spreading of oil spills in the ocean.

Help Received
My mom helped record data that I read off to her during the experiment. She also took pictures of me conducting my experiment. My friend's dad loaned me some scientific equipment from his lab. My dad explained log graph paper to me.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Eric A. Ford

Project Number
S1507

Project Title
Music to My Ears: A Fourier Analysis of Sounds Produced by Acoustic and Digital Pianos

Abstract

Objectives/Goals
My objective was to determine if a distinction could be made between music played on an acoustic piano and the same music played on a digital piano using Fourier analysis. I hypothesized that when examining the Fourier transforms, a difference could be perceived between the recordings from the two piano types because the instruments should produce different frequency patterns, even though the musical pieces played were identical.

Methods/Materials
I used samples of a single musical composition that was recorded on both acoustic and digital pianos, each manufactured by a different company. The recordings were produced in a consistent manner, under similar conditions. Five acoustic pianos and five digital pianos, all of which were professional quality instruments, were included in my study. I converted all the recordings from MP3 format to WAV format to be able to conduct a Fast Fourier Transform (FFT) using Matlab. By issuing a series of commands to normalize the data and calculate and plot the FFTs in the frequency domain, I produced graphs that display the energy of the frequencies. In addition to analyzing the full composition, I isolated a single note from each sample to narrow my field of comparison. I studied the resulting plots to determine if differences in patterns of the frequencies could be found between the sounds produced on the acoustic and the digital pianos.

Results
While the plots of the FFTs of each sample differed from every other plot, similarities existed between the acoustic and digital piano types. FFT plots display a single frequency peak and its harmonics. Harmonics are vibrations of the strings at octaves higher than the fundamental tone, thus adding higher frequencies to the sound. In the analysis of a single note, the acoustic pianos produced more harmonics than the digital pianos. The harmonics of the acoustic pianos also had higher amplitudes or relative energies.

Conclusions/Discussion
I concluded that a distinction between sounds produced by acoustic and digital pianos can be made using Fourier analysis due to the greater number of harmonics produced by the acoustic pianos. The digital pianos also produce harmonics, but not to the same extent as the acoustic pianos. Therefore, despite the fact that digital pianos create sound by reproducing samples of sounds created on acoustic pianos, digital pianos do not produce the same quality of sound as that of the acoustic instruments.

Summary Statement
My project determines whether an audio recording of a musical composition played on an acoustic piano can be distinguished from an audio recording of the same musical composition played on a digital piano using Fourier analysis.

Help Received
Dr. Alan Van Nevel, Mr. Peter Wiley, and Mr. Nick Bling of the Naval Air Weapons Station at China Lake guided me in the use of Matlab and answered my questions about Fourier analysis. My father helped with the use of Matlab and both my parents assisted with the arrangement of my display.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Jonathan D. Grinstein

Project Number
S1508

Project Title
Counting Muon Cosmic Rays from Space

Abstract

Objectives/Goals
Energetic protons from deep space continuously barrage our planet and strike atoms in the upper layers of the atmosphere. Tiny collisions form muons, which are particles with enough penetrating power to reach the earth's surface untouched. The first goal is to build a detector which counts muons. The second goal is to count the number of muons per second and how this changes as the angle of incidence changes.

Methods/Materials
The device consists of two large, flat chambers that are placed on top of each other. A 10% vacuum is reached in each of the chambers. Inside are sets of fine wires and plates of aluminum foil which are connected to a high voltage power supply. This potential creates an enormous electric field near each wire. When a cosmic ray enters this space, it ionizes the atoms it passes by, leaving a stream of electrons, which are picked up by the highly charged wires. The current then goes through the wires to a connected circuit of electronics which registers the current as a count if both chambers record the current; thus, a muon particle is counted.

Results
When the vertical distance between the two chambers increased by two and eight times, the number of counts decreased by 12 and 24 percent, respectively. When the angle in which cosmic rays were counted was 20 and 45 degrees, the number of counts decreased by 46 and 53 percent, respectively. When only one of the chambers was tested for counts, the number of counts was practically identical to that of a comercial Geiger counter; therefore, the individual counters worked well.

Conclusions/Discussion
About one muon per second in a 10 cm^2 area were recorded when the chambers were placed directly on top of each other. My results agreed with my hypothesis in that the number of counts decreased when the angle at which cosmic rays were counted from moved away from the zenith and towards the horizon, and the number of counts decreased when the opening angle decreased. The individual count rate was much higher than that of coincidences because of the natural radioactivity inside of the chambers; a single counter will not eliminate any false counts. This type of radioactivity is too weak to penetrate both chambers and be counted as a coincidence, which is why two counters were used for this experiment.

Summary Statement
To build a muon detector and count the flux of cosmic rays at various angles of incidence.

Help Received
Used Physics demo room at UCSD under supervision of Jeff Paterson. Received guidance from Profs. James Branson, David Macfarlane and my father Benjamin Grinstein. Earl Dollnick helped debugging electronics.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Ryan Hackney; Forest Reid Terry

Project Number
S1509

Project Title
Optical Properties in Reflective Holograms

Abstract

Objectives/Goals
The objective is to determine if the optical properties of mirrors and lenses will perform in reflective holograms.

Methods/Materials
Holograms were made on special glass plates purchases for this project. An isolation table was assembled from custom made high and low frequency isolation dampeners. A steel plate on the top of the isolation table provided magnetic attachment for all lenses, mirrors and the beam splitter that was used in this project. A 7 mw helium Neon laser provides light with a frequency of 633nm to expose the glass plates. A small suitable odject was obtained at a gift store. Chemicals used to develop the glass plates were purchased from a scientific supply house. A metal lathe was used to produce some of the fixtures we used. 24 glass slides were exposed by the laser light. Exposure times of approximately five minutes were used to produce the holograms.

Results
Holograms with a mirror position behind the object and a magnifying lense positioned in front of the object allow the viewer to see a small section of the back of the same object and also, an enlarged portion of the front of this same object.

Conclusions/Discussion
In conclusion, we have found that the optical properties of mirrors and magnifying lenses are fully functional in reflective type holograms. Due to the extreme technical problems encountered in producing and locating holograms on the glass plates, repeating a certain exposure did not alwasy produce a visable and sharp hologram to view. However the holograms that were successfully developed showed us that these properties that we were testing for were indeed present.

Summary Statement
We proved that the optical properties of lenses and mirrors function in reflective type holograms

Help Received
Family friend provided machine shop, tools and some technical assistance

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Michael T. Helmeste

Project Number
S1510

Project Title
The Effect of Wave Guide Geometry on Longitudinal Acoustic Waveforms

Abstract

Objectives/Goals
PROBLEM STATEMENT: The purpose of this project is to determine whether or not the geometry of simple waveguides affects the sound waves put through it, and if so, in what manner.

HYPOTHESIS: My hypothesis is that waveguides (size of 1" to 4" diameter) will have degradation of the higher frequencies, as well as a lower frequency resonance similar to that of sewer pipes. I do not think that bends in the waveguide will have any significant effect on the overall sound. Instead, I predict that such bends will have effects on specific bands of frequencies according to their placement in the waveguide.

Methods/Materials
MATERIALS: (list is abbreviated due to space constraints)(i)Alesis Monitor One Mk2 Studio Monitors and RA150 Reference Amplifier;(ii)Alesis Studio32 16 channel/4 main bus/6 aux bus Mixer;(iii)Alesis XT20 20 Bit/48kHz sample/8 track ADAT Digital Audio Recorder;(iv)Alesis AI3 24 Bit Analog Optical Interface; JLCooper DataSync2 ADAT to Midi Sync;(v) Pentium III desktop computer with SoundBlaster Live and Windows 2000 operating system;(vi) 3 each: 1.5" PVC, 2" PVC, 3" PVC, 4" PVC pipe sections;(vii) 45 degree, 90 degree pipe elbows, and straight thru connectors in 1.5", 2", 3", and 4" sizes; 180 degree "U" bend for 2" pipe and valve for 2" pipe; Various cables and converters, box, stands, microphone,etc.;(viii) Matlab Release 12 and Signal analysis toolbox for Matlab Release 12, SpecLab freeware spectrum analysis software, SoundForge audio manipulation software, Cubase SX software for audio sequencing and sync control.
PROCEDURE: A. Pipe configurations were tested. B. Put the ADAT tape into the recorder, and record the test patterns. C. Set up the waveguide. D. Select record on an ADAT track and route the test signal (track #1) to the studio
monitors. E. Record data. F. Analysis of data using Matlab and other software as needed. G. Repeat of procedure using new pipe configuration until all pipe configurations have been tested.

Results
RESULTS: As the waveguide got smaller, the high frequencies dropped off very quickly, and the low frequencies transmitted with high resonance.

Conclusions/Discussion
CONCLUSIONS: My hypothesis was proven to be correct. Much low frequency sewer pipe resonance was detected among even the best of the waveguides, and high frequencies had significantly greater

Summary Statement
The effect of wave guide geometry on longitudinal acoustic waveforms was studied.

Help Received
Mr. Malin, my physics teacher provided interesting ideas. Mr. Joe Jenkins, cellular radiophone engineer provided information and pictures of waveguides. My parents bought equipment for me.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Ryan J. Honda

Project Number
S1511

Project Title
Radioactive Absorption

Abstract

Objectives/Goals
The purpose of this experiment was to test the hypothesis that the effectiveness of radioactive shielding improved with materials of greater density, thickness, and atomic number by measuring alpha, beta, and gamma radiation penetration through aluminum and lead absorbers with varying thickness.

Methods/Materials
The instrument used to to measure the radiaoactive count was the Geiger-Muller Tube and Counter. Three one minute trials for each source and number of shields was performed for each type of shield. Background noise was subtracted.

Results
Regression lines of the date averages were plotted and compared. Gamma rays proved to be the most penetrating, followed by beta and alpha particles, respectively.

Conclusions/Discussion
Results confirmed the hypothesis and showed lead to be the best absorber of radiation, followed by aluminum shields, and aluminum foil.

Summary Statement
This experiment tested the effects of mass absorption of radioactive substances.

Help Received
Used lab and equipment at Ribet Academy

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Randy S. Hulme

Project Number
S1512

Project Title
Microwaves: How Cool Are They? Correlation Between Molarities and Temperature Change of Solutions if Heated by Microwav

Abstract

Objectives/Goals
To find the relationship between the concentration by mass of sugar in water and the change in temperature of that solution when it is exposed to microwaves.

Methods/Materials
Six solutions were prepared with constant 50 g of water in each and varying amounts of sugar from one to the next, with 0 g in the first, 10 g in the second, and so on with 50 g in the last. After dissolving the sugar with a stirring rod, the temperature was taken. Then, each was exposed to microwaves for 15 seconds in a microwave oven and the change in temperature was recorded. Process repeated five times and results were averaged. Same tests performed with constant 10 g of sugar and varying amounts of water in the same fashion as above.

Results
The higher percentage of water by mass in a substance, the hotter a substance will get if the mass of water is constant. An increase in the amount of water results in a smaller increase in the temperature change. A decrease in the amount of water results in a greater increase in the temperature change. Higher concentrations of sugar result in a smaller increase in temperature change. Lower concentrations of sugar result in a greater increase in temperature change.

Conclusions/Discussion
There is a direct correlation between the concentration of water by mass and the temperature change of a solution. It is so predictable that I derived an equation in which I can predict the exact temperature change of a sugar solution with known molarity and mass (time exposed to microwaves must remain constant). Other solutions can also be applied to the equation, but constants will vary depending on specific heat capacities of solutions and the purity of the solution.

Summary Statement
Figuring out the correlation between the molarities of sugar and water solutions and the change in temperature of that solution when it is exposed to microwaves.

Help Received
Classmate L. Charles Jarrott helped derive the equation. Dr. John Foster (high-energy physicist) helped me understand how microwaves effect substances exposed to them and how that relates to water.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Jeffrey B. Kim

Project Number
S1513

Project Title
The Effect of Weighted Force on Fluorescence Emission of Methyl Salicylate through Triboluminescence

Abstract

Objectives/Goals
My objective is to use the imprinted fluorescence emission of methyl salicylate on Kodak Ektachrome (EL) color film negatives to determine the frequency and wavelength in comparison with data collected from a computer.

Methods/Materials
A weight, with the distance of three centimeters from the substance was used to create the breakage of the crystals.
The light sensor, which is optional, is placed ten centimeters from the substance to record intensity of brightness. With the bluish glow sub sighting, the negatives were developed so proper measurements could be taken. The focal point at which the intensity was greatest was the center of the area with the lightest color of blue. Using a measurement of centimeters, the developed negatives were measured from the focal point to the furthest part of imprint that is visible. The distance of the weight from the substance was increased one and a half centimeters. The increase was stopped after four different distances.

Results
The negatives with the imprints of the fluorescence emission of the substance were developed and measurements were taken from the focal point to the furthest edge of coloration. This data and the usage of Professor Linda M. Sweeting's conversion table helped create the estimated graph in which allowed for the determining of the frequency and wavelength.

Conclusions/Discussion
The hypothesis for the experimentation using the imprinted fluorescence emission of the substance on the negatives to determine the frequency and wavelength to suspect change, states that the weighted force will not affect the outcome at which the frequency and wavelength of the imprinted fluorescence emission of the substance will receive very little or no change at all. Through experimentation, the hypothesis was inconclusive. The primary goal was reached in which finding an alternate way of determining triboluminescence based only on imprinted negatives but method of measuring was all estimation. Calculating the percent deviation has proven that the estimations that were made were in fact close to the real thing. The idea of measuring out the focal point to the end of coloration served as a backbone to the results.
Many obstacles were faced when testing out the hypothesis. For example, the size of the negatives was not taken into consideration. Even after developing the negatives, there was no possible way of estimating the focal point precisely.

Summary Statement
Taking methyl salicylate, force is put upon the substance creating a fluoresecence emission using the process of triboluminescence in which leaves an imprint on the color film negative in order to determine wavelength and frequency.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Michael Kuhn; Spencer Price

Project Number

S1514

Project Title

Two Teens, a Laser, and a Garage: The Story of the Ten Dollar Interferometer

Abstract

Objectives/Goals

The question we are answering is: Is the wavelength that is emitted by our laser a constant. We are using a cheap, non-professional laser, to find out if the quality of the laser affects the constancy of the laser. We have hyposthsized that becuase of the low-grade construction, there will be variations in the wavelength of the laser beam.

Methods/Materials

We are using a Michealson/Morley interferometer in order to prove or disprove our hypothesis. This requires anti-vibration support structure with a metallic sheet on the top. On magnetic blocks, are the components of the interferometer. The laser is shot through a beam splitter, reflected off mirrors, back through the beam splitter, through a diverging lens, which amplifies an interference pattern on to a screen. When the two beams are in-sync, there will be only one interference pattern, but when one mirror is moved, the beams are out of sync, and a second interfernce pattern will appear. By plotting the movement of one mirror against the seperation between the two interference pattern, we can form a sine wave. Whenever this sine wave crosses the X axis, there is only one interference pattern, at the maximums, the second interference pattern is to the right of the center pattern, the minimums represent a second interference pattern that is to the left of the center pattern. By measuring the maximums, minimums and x-intercepts, we can find out if the wavelength is constant.

Results

Our results showed us very clearly the the x-intercepts were evenly spaced, and that the minimums and maximums havve the same Y value every time that they occur.

Conclusions/Discussion

From this data, we can conclude that the wavelength of light emitted from our laser is a constant. We can conclude this becuase interference can be looked at as two beams of light traveling through the same cartesian plane, as a sine wave. One interfernce pattern is viewed when only one sine wave can be seen on the cartesian plane. When one beam is shifted laterally, two beams can now be seen, criss-crossing. By proving that the x-intercepts are evenly spaced, we have proven that only one beam on the cartesian plane can be seen when one beam is moved a certain constant distance. By proving the the minimums and maxiumums are the same, whenever they occur, we can say that the crests and troughs of the wavelength are constant as well. Thus, we have proved a constant laser beam.

Summary Statement

We use a Michealson/Morley interferometer to figure out whether light from our laser is constant or variable.

Help Received

Used lab equipment from University of California at Santa Barbara in our garage, supervised by Dr. Mark Sherwin

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Peter A. Lee

Project Number
S1515

Project Title
Challenging the Theories of Dark Energy and the Expanding Universe with Photon Drag Mechanisms

Abstract

Objectives/Goals
Challenging the notion that intergalactic redshift is caused solely by Doppler-style galactic recession, this project identifies and characterizes two previously unevaluated non-Doppler causes of redshift to determine whether these tired-light photon energy loss mechanisms, gravitational drag and electric field drag, contribute to intergalactic redshift, thereby reducing or eliminating the need for the stop-gap theory of dark energy.

Methods/Materials
To evaluate the impact of photon drag mechanisms, two physics-based finite element computer models were written to analyze gravitational drag and electric field drag.

Results
The models successfully characterized gravitational drag and electric field drag and determined that they contribute at least part or perhaps all of observed intergalactic redshift.

Conclusions/Discussion
Given these results, the Doppler effect must play a smaller role in causing intergalactic redshift, which means that the universe is expanding more slowly, if at all, than is currently believed. Consequently, dark energy may not exist.

Summary Statement
Analyzing previously overlooked interactions between photons and deep-space hydrogen atoms reveals that the universe may not be expanding and dark energy may not exist.

Help Received
Parents helped assemble board

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Olga V. Mandelshtam

Project Number
S1516

Project Title
Computer Simulation of van der Waals Clusters

Abstract

Objectives/Goals
Van der Waals clusters are groups of chemically neutral atoms or molecules with weak forces of attraction, the Van der Waals forces. They occur naturally and are created in laboratories by jet expansion. My objectives were to study the properties of Van der Waals clusters by computer simulation. I was interested in finding if and how the structures and stabilities of the clusters depend on their sizes.

Methods/Materials
I wrote two computer programs (for two-dimensional and three-dimensional clusters) in C to model the configurations of clusters of different sizes. I used the Monte Carlo method in my algorithm to find the equilibrium configurations. I plotted the configurations of the clusters and I compared their stabilities and analyzed their properties.

Results
I found that all the two-dimensional clusters are sections of a hexagonal lattice. All the clusters are very compact and symmetrical. The most stable two-dimensional clusters are the most symmetrical. Thus the most stable three-dimensional clusters must also be the most symmetrical.

Conclusions/Discussion
This information can help me analyze and interpret results for larger clusters that cannot be pictured. Finally, a parallel can be drawn between clusters and atoms. Just as atoms have certain sizes that make them most stable, namely the inert gases, so do clusters.

Summary Statement
I studied the properties of Van der Waals clusters by computer simulation.

Help Received
My father helped run my programs on his computers and gave me general advice on numerical algorithms; my mother helped proofread my report; a friend helped fix syntax errors in my program.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Ashley N. Muirheid

Project Number
S1517

Project Title
Does the Color of Fabric Influence the Degree of UVR Penetration through Clothing?

Abstract

Objectives/Goals
The objective was to compare various colors of the same fabric in terms of their effectiveness as barriers against UV radiation. My hypothesis was that the darker fabrics (black, purple, and red) would allow fewer UV rays to penetrate.

Methods/Materials
Fabric-covered petri dishes containing YED agar and UV-sensitive yeast (saccharomyces cerevisiae) were exposed to sunlight for 6 hours. Three samples each of 8 colors of the same fabric were tested, plus uncovered controls. Yeast growth was compared at 48 hours. Fabric weight, thread count, and fiber analysis via SEM images were used as a means to analyze yeast growth results.

Results
The white sample clearly performed the worst, followed by yellow, then tan, blue, and green. The darkest colors (red, purple, black) performed best.

Conclusions/Discussion
My hypothesis was correct in that the darker colors were more UV-effective than the lighter colors, especially white. These results suggest that individuals desiring to minimize UV-exposure should opt to wear darker colors. The total area of the air spaces in the weave of the darker fabrics were less than that of white, suggesting that the dye particles precipitated onto and within the fibers, thereby allowing less UV rays to penetrate. Further study is necessary to determine the relationship among UV penetration (this study), absorption, and reflection in order to develop more UV-protective attributes for light-colored clothing.

Summary Statement
After testing 8 colors of the same fabric using UV-sensitive yeast, it is determined that the darkest colors are the most effective as barriers to UV radiation.

Help Received
My lab materials were provided by Mrs. E (Reedley Jr. College); Mr. K (Fresno State), and my high school. Dr. B. from Fresno State taught me how to use the SEM. My mother chaperoned me at appointments; my father helped with digital photos.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Anthony T. Nguyen

Project Number
S1518

Project Title
Thermoacoustics: Creating Sound with Heat

Abstract

Objectives/Goals
The objective is to understand and demonstrate the thermoacoustic phenomenon, which uses heat to initiate the oscillation of gas without moving parts. The second objective is to characterize the properties of a thermoacoustic engine as a function of the stack position inside the test tube, the length of the test tube, and the applied power. My hypothesis is that a smaller resonant cavity will result in a lower pitched sound, lower sound intensity, and longer sound onset time. Also, it is hypothesized that increasing the applied power will shorten the time of sound onset and increase the sound intensity.

Methods/Materials
For the thermoacoustic engine, I used a Pyrex test tube to house the engine. The stack material inside the test tube is a ceramic cube with airflow-channels in the axial direction. Nichrome heater wire is placed at one end of the stack near the closed end of the test tube. DC voltage is applied to the heater wire to create the temperature gradient across the stack. I varied the stack position and applied different power levels to the stack and studied the generated sound. The data collected includes the applied power, time of sound onset, the temperature of the hot end, and the sound intensity and frequency.

Results
The results of my tests are divided into two sections. First, I used a fixed stack position and plotted the temperature at the hot end, the sound intensity, and time of onset as a function of the applied power. The temperature at the hot end and sound onset time decrease as the applied power is increased. The sound intensity increases as the applied power increases. Second, I plotted the time of sound onset, the temperature at the hot end, the energy absorbed by the stack, and the frequency as a function of the stack position. The time of onset, the temperature at the hot end, and absorbed energy are minimized when the stack is positioned near the middle of the test tube. The frequency of the generated noise is not affected by the stack position.

Conclusions/Discussion
The thermoacoustic engine can generate sound using heat only without moving parts. As the applied power to the stack is increased, the intensity of the generated sound is increased. The time of onset and absorbed energy are minimized when the stack is positioned near the middle of the test tube. In my survey, the general public knows about acoustics, but they are less informed about thermoacoustics.

Summary Statement
I studied and tested a simple thermoacoustic engine to demonstrate that it is possible to generate sound by using applied heat.

Help Received
My mother helped format various materials. My father helped build the apparatus and edit the report.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Laila M. Nikaien

Project Number
S1519

Project Title
Comparison of the Insulating Value of Farm Animal Fats within Warm and Cold Environments

Abstract

Objectives/Goals
The purpose of the experiment was to determine whether pig, chicken, cow, or sheep fat offers better insulation. If 1 pound of pig, chicken, cow, and sheep fat are tested individually in 4 different temperature environments (inside, outside, heated room, and refrigerator) then the insulation qualities can be measured and the best insulator can be determined. Knowing the insulation values of the fats in addition to the other known insulating elements that these animals have, will help farmers raise their animals more effectively.

Methods/Materials
Four plastic bags were filled with 1 pound of pig, chicken cow, and sheep fat. A thermometer was positioned in each bag. All 4 bags plus an empty bag, as the control, were placed in cold environments (outside and refrigerator) and in warm environments (inside and pre-heated room) for a period of 2 hours. The 5 bags were adjusted to the same initial temperature, placed in one of the four temperature environments, and the temperature of each bag was recorded every #ö hour.

Results
Based on the data collected during the experiment, the chicken fat maintained the most constant temperature for the majority of the experiment duration for the cold environments. The chicken fat changed an average of 3.6¢ª over the period of 2 hours, for the 6 days. This is the smallest average degree change for the cold environments. (The animal fat that offers the best insulation will have the least average degree change.) The sheep fat on the other hand, maintained the most stable temperature for the duration of the experiment for the warm environments. The sheep fat changed an average of 7.29¢ª over the period of 2 hours, for the 6 days. This was the smallest average degree change for the warm environments.

Conclusions/Discussion
All in all, chicken fat offered the best insulating qualities in cold environments, while sheep fat offered the best insulation in warm environments. These findings, along with further research and experimentation concerning other insulating factors (skin/hide, feathers, fleece) could yield a more specific conclusion pertaining to what kind of thermo-neutral zones these animals should be raised in most effectively. The thermo-neutral zone is defined as the range of temperatures that an animal finds comfortable.

Summary Statement
The purpose of the experiment was to determine whether pig, chicken, cow, or sheep fat offers better insulation.

Help Received
Mother helped paste material on display board. Father helped proofread research paper.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Daniel Serrano; Kathryn Vickery

Project Number
S1520

Project Title
Blocked Frequencies

Abstract

Objectives/Goals
The objective of the project was to test the effectiveness of various types of earplugs using a Vernier decimeter to detect how much sound the earplugs blocked.

Methods/Materials
A styrofoam mannequin head was purchased and holes were drilled to represent ear canals. Holes were drilled from each ear to the center and a seperate hole was drilled into the back of head and intersected the ear canal hole. Earplane, Flint, Mack's Pillow Soft, Howard Leight earplugs were tested. A computer generated gunshot was the sound used to test the earplug's effectiveness in blocking sound. The Vernier decimeter(model # 407740) was inserted into the back of the mannequins head and hooked up to a laptop computer. Using LabPro software the decimeter graphed the amount sound that passed through the earplugs. The y-axis represented the amount of deciples and the x-axis represented time.

Results
The experimental control (no earplugs) measured 84.03 dB. The Howard Leight Earplugs measured 73.38 dB. The Mack's Pillowsoft measured 65.32dB. The Earplane earplugs measured 75.97 dB. The Flint's earplugs measured 74.24 dB. The Mack's Pillowsoft earplugs blocked 18.71 dB more than using no earplugs; 8.06 dB more than the Howard Leight; 10.65 dB more than the Earplane; and 8.92 dB more than Flint's.

Conclusions/Discussion
The Mack's Pillowsoft earplugs blocked blocked 18.71 dB more than the control causing them to be the most effective form of ear protection tested.

Summary Statement
This project tested the effectiveness of different types of earplugs, utilizing Vernier technology.

Help Received
N/A

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Cameron J. Shepherd

Project Number
S1521

Project Title
Beta and Gamma Scintillation Detection and Assessment of Fluvial Radioactivity

Abstract

Objectives/Goals
My project evaluated liquid and solid scintillation to determine the feasibility of using these methods to detect trace levels of fluvial radioactivity. After doing research, I decided liquid scintillation could detect minute traces of weak radioactivity that might be present from natural or man-made sources.

Methods/Materials
I made a radiation and light-shielded apparatus out of lead and cloth. Using a photomultiplier tube, I built a scintillation photodetector. I compared the effectiveness of liquid scintillation detection to a plastic scintillator and a sodium iodide (NaI) scintillator. I also visually investigated the response of several solid scintillators and phosphors to radiation from radioactive ore. I created dissolved ore samples with varying pH to simulate fluvial radioactivity that might come from weathered rocks.

Results
I analyzed 85 fluvial samples from the Pacific Ocean, rivers of the Northwestern US, and the dissolved ore. My liquid scintillation photodetector was more sensitive than the NaI. I detected tritium showing that it could detect low energy beta and alpha particles that could not penetrate the aluminum housing of the NaI detector. I discovered radioactivity in Pacific Ocean samples taken near Russia and China at about six times background levels with a 99 % confidence level. Samples from eastward and westward voyages across the Pacific showed reproducible detection. Use of dissolved ore showed that scintillation molecules seemed to be affected by pH. The less sensitive plastic scintillator was able to provide satisfactory detection at pH extremes.

Conclusions/Discussion
Short 15 minute counts using liquid scintillation detected low levels of low energy radioactive materials in oceans and rivers with high statistical confidence. Using the NaI detector, there was no ability to detect radioactivity from the same samples even with seven hour counts and 20 times more sample. There were interesting trends in the fluvial samples from the Western US, further supporting my hypothesis that detection of extremely low level radioactivity might help to provide insight into geologic processes.

Summary Statement
This project evaluates scintillation as a method to detect varying levels of radioactivity in fluvial environments.

Help Received
The LA Section of the American Nuclear Society loaned me a sodium iodide detector. My grandparents and uncles helped collect samples (Pacific Ocean, Columbia River, and Lassen drainage). My parents bought the components I wanted and provided critical review of my report and board.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Steven Young

Project Number
S1522

Project Title
How Does the Distance between Two Super Magnets in a Magnetohydrodynamic System Affect the Overall Thrust?

Abstract

Objectives/Goals
The objective of the project was to investigate the properties of magnetohydrodynamics. Basically an MHD model was set up and a current was sent through it. Then a force was calculated from the relieved weight on a scale and then compared to the varying distances between the magnets. It was hypothesized that the force was proportional to the inverse of the distance between the magnets squared.

Methods/Materials
A model was made with 2 blocks of wood. Each block had a super magnet glued on, and connected by 4 rods on the corners. They were able to be moved up and down, with each block attracting the other. The bottom block was fitted with electrodes.
This model was placed in a salt solution and wires were connected to the electrodes and a generator. The model was also connected to a Styrofoam piece on a scale, connected by a light cloth string. The generator was turned on and the negative weight on the scale was read off and converted to the force generated by the model. The amperage and the distance between the current was changed to create more data and trials.

Results
The force versus the distance graph showed a hyperbolic curve, while the force versus the inverse of the distance showed a straight line, but not through the origin. A graph of the force versus the inverse of the distance squared showed a straight line through the origin.

Conclusions/Discussion
The hypothesis was confirmed through a graphical analysis of the data. However not all data points went through the origin by the line, so therefore there were some margins of experimental error. Gas bubbles from the electrolysis, unforeseen angles between the model and the Styrofoam piece and the model and the wires, and the not uniformly spread magnetic flux density lines between the two magnets all caused sources of error.
This project can be further investigated to calculate the actual average magnetic flux B between the magnets. Also it could be related to other ongoing investigations involving the study of plasma as an electrical conducting liquid and sending a current through it, thus spreading ions and creating energy.

Summary Statement
The goal is to find how the distance between magnets affect the thrust of the system.

Help Received