CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Sarah J. Adams

Project Number

S1501

Project Title

The Measurement and Isolation Analysis of Alpha, Beta, and Gamma Emissions from Uranium Decay and Its Daughter Nuclides

Abstract

Objectives/Goals

The purpose of my project is to effectively isolate and independently measure the different radioactive emissions from the uranium oxide glaze on the bowl so that proper shielding can be analyzed.

Methods/Materials

After obtaining access to a radioactive source for Uranium decay found in the glaze of a pre-1940 Fiesta Ware bowl, I then acquired an alpha meter, gamma meter, and an activity count meter to measure the different types of radiation being emitted from the bowl. After recording a static number of particles being emitted in the forms of alpha, beta and gamma radiation, I then began to test various shielding materials to investigate which material reduced the number of particles that the meters received. As I measured emissions outside of the normal Uranium decay patterns, I then studied the Chart of the Nuclides and was able to determine that there were other daughter nuclides of Uranium present also emitting radiation.

Results

Due to the large size and low energy of an alpha particle, a simple sheet of cellophane will completely block all forms of alpha radiation. Beta radiation is much smaller, found in the form of an energized electron expelled from an atom that is atomically unstable. Through my testing I found that the most optimum shielding material against beta radiation was water and dense objects, primarily any material that is an efficient electron absorber. And gamma radiation was reduced the most by cement and other materials with similar densities. And my measuring the emissions, I was also able to determine that the bowl was also emitting high energy beta particles that was penetrating shielding that would normally stop low energy beta. This proved that there were other daughter nuclides of Uranium present in the glaze because Uranium is primarily an alpha emitter, whereas its daughter products emit higher levels of beta.

Conclusions/Discussion

In understanding the unique principles of radiation, one gains a certain insight into the benefits of harnessing nuclear energy, as well as the harmful side effects of the misuse of nuclear waste and weaponry. In today#s society, the views on anything nuclear is so polarized that the only way to make an informed decision about the beneficial uses of nuclear physics is to have an in depth understanding about its exceptional properties.

Summary Statement

My project is about he study of the Uranium decay chain and its daughter nuclides.

Help Received

Radiation Safety Officer George Barnet, who is employed by a radiactive waste management company in Oak Ridge, TN helped providethe instrumentation; Bill Huchabee, Radiation Detection Equiptment manager from Ludlum Measurements Inc. helped with the instrumentation set-up

Name(s)
Abraham Badakian; Kevork Khadarian

Project Number
S1502

Project Title
The Effects of Inertia, and the Potential Energy on Different Kinds of Masses, Shapes, and Dimensions

Abstract

Objectives/Goals

Our experiment tests the conservation of energy, which states that energy cannot be created nor destroyed, it only changes form. Based on the researched we gathered, we predicted that the sphere would have the greatest acceleration and finish quickest, due to its greatest resistance to friction, which then leads to the least rotational kinetic energy. The results show that that the spheres are most resistant to friction, waste the least amount of rotational kinetic energy, as well as had the greatest acceleration of them all proving our hypothesis correct. The hoops had the slowest times, therefore had the slowest acceleration, and required the most amount of rotational kinetic energy. The main things we concluded out of this experiment were the following: 1. The objects that have the least amount of rotational kinetic energy will finish first, regardless of mass, size, and radii. The sphere will reach the bottom of the ramp the fastest, followed by the discs and later the hoops. 2. The higher the slope of the ramp, the bigger the translational kinetic energy (dependant on acceleration), the smaller kinetic rotational energy. Therefore the objects rolled down the higher incline will reach the bottom quicker compared to the objects rolled down from the lower incline. 3. The smaller the mass of the object of the same type, will reach the base faster than the other.

Summary Statement

This project proves least rotational kinetic energy corresponds to the fastest moving object

Help Received

all done by group members

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Peter K. Blanchard

Project Number

S1503

Project Title

The Weird World of Planets in Binary Star Systems

Abstract

Objectives/Goals

For centuries, scientists have been exploring the wonders of binary star systems. We have come a long way since the studies of Ptolemy who acknowledged the first binary star, Eta Sagittarii. But until recent discoveries, planets where thought to be absent in binary systems whose stars were relatively close. Now, new research has begun into the weird world of planets in binary star systems. Using a custom written gravity simulation software program, observations can be made of the affects of a binary system on a planet orbiting one of the stars in the system.

Methods/Materials

By varying the separation (in Astronomical Units), mass (in Jups), and velocity of the planet, one can observe a planet#s orbit in a binary system. Planets were placed into ten real binary systems using the software. The hypothesis stated that the affect on the orbit of the planet will depend on the relative mass of each star, separation between the stars and the orbit and mass of the planet.

Results

When the separation between the two stars was greater, the two stars in the binary system had a small effect on the orbit of the planet. But when the velocity or separation of the planet was increased, the two stars had a greater effect on the planet. The changes in the mass of the planet had little effect on the orbit. During the orbit of the planet orbiting the star HD 185507, the planet switched orbits to the other star.

Conclusions/Discussion

Through observation of planetary motion in binary star systems, it has been acknowledged that planets will be unable to survive for long periods of time. The effect of the binary star system varies depending on the distance between the two stars and the mass, velocity, and separation of the planet. One objective was to see if a planet could switch orbits between stars. This happened with the star system HD 185507 but the orbit was not sustained for long. What a weird world it would be to be living on a planet with two suns rising and setting at different times.

Summary Statement

The observation of the effects a binary star system would have on a planet orbiting one of the stars.

Help Received

Father helped edit; Science teacher helped edit and provide advice; Cousin helped with custom software

Name(s)

Eric P. Casavant

Project Number

S1504

Project Title

Helios Anchor Light: A Novel Approach to the Design and Engineering of Anchor Lights with LED's to Increase Efficiency

Abstract

Objectives/Goals

The objective of this project was to design and engineer the most efficient anchor light on the market. To achieve this, my plan was to utilize LED's placed under a parabolic reflector, so that all the light goes exactly where it is needed most, strait out.

Methods/Materials

The LED's are placed in a circle around a central, cone like reflector. To calculate the amount of LED's required in the prototype to prevent blind spots (places where no light is shining), I first had to find out the degrees in which light was being emitted. The LED's I used for my first prototype were quite directional, with a light output of 18 degrees. This ment I had to have 20 LED's in order to have no blind spots. I then had to make the cone shaped parabolic reflector. To do this, I first calculated the light focusing parabola, assuming that the LED was the focus. I then had to cut 20 pieces of high reflective cardboard paper in such a way that when they were all adheased together, they assembled into a cone with the calculated parabola above each LED. To do this, I had to simply break up the parabola into nearly 100 triangles with excel. When I did that, I could find the length of the parabola line, given a certain point on the porabola. I then assumed that the length I found was the hypotenuse of a triangle. This length is then seen as the "y axis" of the 20 pieces that were to be put together. The "x axis" point was then found using basic triganometry acording to the "y axis". With several points I was able to come out with the parabolic curve of these pieces.

Results

The light emitted from the LED's was a perfectly focased horizontally spreading beam. The beam was in fact four times more focased than if the LED's had no parabolic reflector. This means that the prototype was around 2.5x more effecient than the conventional meathod of mounting LED's on there side. The matierial used for the parabolic reflector was also extremely reflective, coming in with about 96% reflectivity. The prototype consumed a mere 1.8 watts, and emitted a beam of 1190 lux at 1 foot. The same LED without the parabolic reflector emited 500 lux at 1 foot.

Conclusions/Discussion

My idea of placing LED's under a parabolic reflector to focus the emitted light all where it is needed most was a success. The outcome was a product that was 2.4x more effecient than even then the most effecient LED anchor light available.

Summary Statement

The objective of this project was to design the most efficient anchor light available using LED's placed under a flawlessly calculated parabolic reflector so that all light emitted is focused perfectly horizontally.

Help Received

Teacher bought supplies and helped with electrical equations. Father helped with some mathimatical equations.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Bryce W. Cronkite-Ratcliff

Project Number

S1505

Project Title

The Unbearable Beingness of Light: A Study of the Mysterious Nature of Light

Abstract

Objectives/Goals

In the 17th century, physicists such as Newton and Hooke debated whether light was a particle or a wave. Decisive experiments around the turn of the 18th century resolved these debates conclusively in favor of the classical wave theory. But in the early part of the twentieth century, experiments that studied the photoelectric effect required light to also have particulate properties. Theoretical explanations to resolve these disparate pieces of evidence gave birth to the modern quantum theory of light, where particles may act, in some sense, as both waves and particles simultaneously. This project presents a number of experiments that demonstrate, first, why the wave theory was accepted in classical physics; second, why light must sometimes be considered a particle; and third, how the interference associated with the classical wave theory occurs even when there is only a single "particulate" photon in the apparatus at any one time. The only known explanation for these behaviors is quantum mechanics.

Methods/Materials

To demonstrate that light exhibits the wavelike property of interference, I perform updated versions of classical experiments (Young's Slit and Poisson's Spot). Then using a single photon detector, I show that light exhibits particulate properties. Finally, I repeat some classical experiments at very low light levels using the photon detector to measure the interference patterns.

Results

As expected, I was able to repeat the classical experiments and show the interference patterns indicative of the wavelike properties of light. However, with my single photon detector, I was able to show that photons are detected as individual particles. Repeating the classical experiments, I demonstrated that, even at photon counting rates so small that only one photon is in the apparatus at any one time, the "wave" interference patterns are still observed. In a sense, the photons seem to be interfering with themselves.

Conclusions/Discussion

I observed that light exhibits both wavelike and particulate properties. However, neither of these properties can be those of our common sense perceptions of them. The only known explanation of this is the theory of quantum mechanics, which predicts the behavior of light very well, but doesn't allow us to feel comfortable saying we "understand" light.

Summary Statement

My project experimentally studies the properties of light and demonstrates its quantum nature.

Help Received

Dr. Jaroslav Va'vra assisted me in acquiring the necessary materials. My dad acted as my mentor on the project, helping my understand some of the science and helping me conduct experiments where multiple people were necessary. My mom helped me proofread my writeup.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Erica Fernandez

Project Number
S1506

Project Title
What Is the Better Insulation Material?

Abstract

Objectives/Goals
The objective of my project was to find out which of a variety of materials, which are commonly used in home construction acts as best insulator against heat. My hypothesis was "if the material has a higher R value (resistance to heat flow, then it will act as better insulators."

Methods/Materials
I tested convention and conduction of several insulators ten samples of each one for only ten minutes. I used the following materials, heat source, insulators, lamp, 2 wood bases (open spaces), thermometers, 100Wt bulb, hold stand, goggles, gloves, R values, chronometer and ruler.

Results
According to my results they differed from previous researchers in the way that the bubble pack was the best insulator in their results, but in mine it was fiberglass.

Conclusions/Discussion
My conclusions showed thst the materials tested generally followed R values.Since the the R value of fiberglass was the highest, the results showed it was the best insulator. I proved my hypothesis to had a highly significant difference of the materials by using a statistical analysis.

Summary Statement
To find an insulator that acts against heat and that it follows its R value.

Help Received
Mr. Callway and my family help me accomplish this task by supporting with their help and materials.

Name(s)
Reyna D. Garcia

Project Number
S1507

Project Title
What Is the Effect of Sunspots on Radio Reception?

Abstract

Objectives/Goals
I set out to do this project because I wanted to extend and correct the project I conducted last year. I wanted to demonstrate that the correlation I found was not simply due to my human error, but that there in fact was more to it. I wanted to show that sunspots indeed have an effect on radio reception.

Methods/Materials
Materials : 1. 10 portable radios; 2. 10 stop watches; 3. Open area with decent reception; 4. Paper/pencils; 5. Computer; 6. Daily sunspot activity charts.
Procedures: 1. Set up all ten portable radios in open area with decent reception. 2. Set them to the same station. 3. Have ten people sit for an hour and listen for static. 4. If there is static time its duration. 5. Record findings. 6. Repeat steps 1-5 every weekday for two weeks. 7. Analyze raw data.

Results
I found that there is a positive correlation between the number of sunspots and the quality of radio reception.
On days when there was one active sunspot there was a recorded average of 0.72 seconds of static per one hour period, on days with two active sunspots an average of 1.64 seconds, on days with three active sunspots an average of 3.87 seconds, on days with four active sunspots an average of 5.01 seconds, on days with five active sunspots an average of 6.28 seconds, on days with six active sunspots an average of 6.72 seconds, and on days with seven active sunspots an average of 7.13 seconds . On February 18th, 2006 there were no sunspots affecting the region where the experiment was conducted, and because of that I chose it to be my control. As expected, on that day no static was detected.
The results obtained may be explained by the electromagnetic bombardments caused by sunspots that disrupt radio waves.

Conclusions/Discussion
The more sunspots there are, the poorer radio reception is.

Application/Reflection
I did this science fair project because I wanted to see to what extent nature still had control over the technology we have worked for over five decades to perfect. My findings help illustrate that even in an age where technology is so greatly revered, we are still at the mercy of a force which at one point in history has also been venerated for its immense influence on Earthly matters.
My findings show that at least to some extent sunspot activity affects radio reception.

Summary Statement
The sun undoubtedly affects many aspects of earthly matters, my project helps exemplify how sunspots affect something we are all familiar with, the radio.

Help Received
First and foremost I would like to thank Jan Alvestad, who compiles solar information from SOHO and the Solar Region Summary provided by NOAA/SEC for public access. I would also like to thank all of the people who volunteered their time to help me collect all of the necessary data, and my parents for funding.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Margaret L. Hatch

Project Number

S1508

Project Title

Twinkle, Twinkle, Little Star: Adaptive Optics and Its Role in Stellar Scintillation

Abstract

Objectives/Goals

Does atmospheric pressure, temperature or humidity affect stellar scintillation?

Methods/Materials

1 pair of high power binoculars or telescope
1 stopwatch or timer
1 scientific journal
1 computer with Internet access, or a television with cable access
Select a star with which you will test your hypothesis. Discover and organize a time to take measurements. Using your Star Finder, locatate your star. Once you have found your star, locate actual star using your magnification equipment of a telescope or binoculars. Once you located your star, set your timer, stopwatch or timer to 1 minute. Once you press the button, begin to count the number of times the star #twinkles,# stopping when the counting device goes off. Record your observations in a scientific journal. Using the Internet or television, discover the current temperature, air pressure and humidity when you took your calculation, and discover the amount of telescopic adjustment used by the Palomar Observatory for that time period in order to compare results. Record findings. Analyze charts and raw data to form a conclusion.

Results

The data supported my hypothesis that temperature affects the amount of stellar scintillation that can be witnessed in a one-minute period, but disproved my hypotheses that air pressure and humidity also affect stellar scintillation. My data was supported by my research into the use of lasers to improve the visibility. The refractive index inhomogeneities of the turbulent air cause wave-front distortions of optical waves propagating through the atmosphere, leading to such effects as beam spreading, beam wander, and intensity fluctuations (scintillations).

Conclusions/Discussion

If I were to conduct my experiment again, I would change my technique for gathering and collecting data. There are so many variables involved when viewing the stars, that I would like to have been able to use a high-powered telescope, binoculars and the naked eye, and compared the different rates of scintillation that occurred for each, thereby providing myself with more conclusive data.

Summary Statement

I tested the variables that lead to intensity fluctuations of the stars and how adaptive optics helps with compensating for those variables.

Help Received

Mr. William Hatch and Dr. Catherine Ohara helped with the comprehension of the components of adaptive optics. Dr. Jonathan Koramora helped with the astronomy aspect of my project.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Rebecca D. Hicks

Project Number

S1509

Project Title

Slow Flow: A Study of the Effect of Temperature on Viscosity

Abstract

Objectives/Goals

The order of the liquids from lowest viscosity to highest viscosity will be olive oil, motor oil, and corn syrup; the viscosity of a liquid is inversely proportional to its temperature; the liquids will decrease in viscosity and the temperature increases, or increase in viscosity as the temperature decreases, in a common manner; the magnitude of the effect that temperature will have on a liquid#s viscosity is directly proportional to the average viscosity of the liquid.

Methods/Materials

Falling ball viscometers were assembled. Transparent PVC pipes were cut into three lengths of about 1.1 meters each and capped on one end with plastic caps using purple primer and PVC pipe cement, filled with a liquid and a ball bearing each, and capped on the other end. An equation derived using Stoke#s Law of Laminar Flow was found to calculate the viscosity of the liquids based on the time it took the ball bearing to fall through a certain length of the tube. The viscometers were placed in a bathtub filled with water of a known and cooling temperature, and the time it took the ball bearing to fall through the tube was measured at intervals of 0.5 degrees C. This time was used with each temperature, the diameter of the ball bearing, the acceleration due to gravity, the densities of the ball bearing and the liquid, and the length through which the ball bearing fell in the afore mentioned equation to calculate the coefficient of viscosity for each liquid at each measured temperature. The recorded data was entered into tables for analysis.

Results

As the temperature of the liquids increased, the viscosity of the liquids decreased. Olive oil was the least viscous, corn syrup was the most viscous, and motor oil was in between these two. The trend of the viscosity versus temperature curve does not appear to be common among the liquids. Corn syrup showed the greatest change in viscosity over the temperature range, motor oil showed the least change, and olive oil was between these two.

Conclusions/Discussion

The data support that the order of the liquids from least viscous to most viscous is olive oil, motor oil, and corn syrup, and that viscosity shares an inverse relationship with temperature; the data do not support the existence of a universal viscosity v. temperature curve or that the effect that temperature will have on a liquid#s viscosity is directly proportional to the average viscosity of the liquid.

Summary Statement

The project is about the effect of temperature on the viscosity of a liquid and the possibility of a universal relationship between the liquid viscosities and temperature.

Help Received

Materials were lent by Mr. Mark Grubb for use; other materials were located by father; father assisted in the construction of the falling ball viscometers

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Lindsey M. Lewis

Project Number

S1510

Project Title

Beta Busters and Gamma Grabbers: A Study of Radiation Shield Effectiveness

Abstract

Objectives/Goals

This project was to determine which material would be the best shield against beta and gamma radiation. Often times, radiation needs shielding because it causes harm to the environment. Radiation can be used in many important ways such as cancer treatment, sterilizing, and as a power source. Radiation can only be useful if it is controlled; shields are often used for this purpose.

Methods/Materials

This project was conducted at the Isotope Products Laboratory in Burbank,CA. A disk of Cesium-137 was placed on a crate in the center of a 2" high tape roll. The tape roll was used to hold the shield in place and to ensure that the distance between the radioactive source and the shield remained constant. A Geiger Mueller Counter was used to measure the background radiation. The bare source was also measured with the counter to ensure accuracy. The Geiger Mueller Counter was used to determine which of the tested materials stopped the most beta and gamma radiation from penetrating. 48 tests were completed, results were recorded and analyzed using the linear attenuation coefficient equation to eliminate the thickness variable in order to determine the most effective shields.

Results

Materials with high linear attenuation coefficient values are the best shields because they block the most beta/gamma particles. The materials with the highest μ values (above 200) included aluminum flashing (1-7 layers), plaskolite (1 layer), vinyl, aluminum foil (8 layers) and the Molybdenum. The next best shields, where μ=199-100, were aluminum flashing (8-10 layers), vinyl (2 layers), aluminum foil (4 and 16 layers), and plaskolite (2 layers). The shields with μ values below 100 included copper, aluminum tape, lexan, carbon, kapton, Tupperware, rubber, mirror, Plexiglas, cast iron, airflow baking sheet, fiberglass, marble, polyethyline, graphite, paraffin, foam insulation, and Styrofoam.

Conclusions/Discussion

Cast iron was among the worst shields with a μ=8. Three layers of aluminum flashing were the best with a μ=466. The aluminum products fell between 466 (3 layers of aluminum flashing) and 8(the air-flow baking sheet). Plaskolite was also very effective with a μ=219. The worst shields, with μ values below 1, were the foam insulation and Styrofoam; probably due to their porous compositions. The top 6 shields, were different combinations of aluminum flashing, this was interesting due to the lightness of the material.

Summary Statement

Forty-eight materials were tested for gamma and beta radiation shield effectiveness.

Help Received

Cary Renquist (Radiation Safety Officer/ Isotope Products Laboratory), Marissa Renyolds (Nuclear Physicist formerly at IPL, equation help), Michael Holmes (Nuclear Physicist / Air Force Research Lab, equation help), parents (drove), Mr. Mark Grubb (HS physics; supplied fiber glass, Lexan, & carbon).

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Alexis E. Nitti

Project Number

S1511

Project Title

2 + 2 = Less Than You Think

Abstract

Objectives/Goals

It has been said that the physical addition of two separate volumes of water and alcohol will result to less than the projected amount. However, could this merely be a fact lost in history through misunderstanding? Or could two plus two, or really any increment, add up to less than four?

Methods/Materials

To answer this question the long, but simple, task of measuring out individual increments of fluid and combining them within the 100ml graduated cylinder where they would again be measured, was begun. As the experiment proceeded new aspects of it were discovered, like the fact that it#s exothermic.

Results

The resulting data is illustrated through detailed graphs and charts. The results are categorized into four sections: combination, physical results, projected results, and % difference. For example, (respectively) 50 ml alcohol/50 ml water, 95.12 ml mixture, 100 ml mixture, 4.88% in clearly displayed in a chart. The experiment was run and recorded over one hundred times. Because the sample size ranged from a mere 10 ml to 100 ml, the data presents a broad spectrum of the results of hydrogen bonding on the mixing of water and alcohol.

Conclusions/Discussion

While the method is simple, its significance is everlasting. The experiment proved that the physical volume of mixing alcohol and water won#t equal its projected volume. All industries, even NASA, must understand the properties of alcohol and water. It is with this knowledge that they can be more efficient and accurate.

Summary Statement

What we have come to believe about the physical world may not be true, and two plus two may not equal four.

Help Received

My brother helped me come up with the idea.

Name(s)
Nick L. Okita

Project Number
S1512

Project Title
The Impact of Construction Materials on the Attenuation of Sound

Abstract

Objectives/Goals
My project is to determine which construction material will result in the most sound reduction at various sound levels. My hypothesis is that the 2" brick will outperform the other materials because it is the thickest.

Methods/Materials
A sound source (speakers) is placed at one end of a six-foot cardboard sound chamber emitting white noise, and the sound level meter is placed on the other end of the chamber. The sound chamber is split in two parts for the insertion of the sound reduction material. These one-foot by one-foot materials include: mirror, acoustic tile, Styrofoam insulation, 2" concrete brick, 1 3/4" concrete brick, 1½" clay brick, and wood that has widths of 3mm, 6mm, 9mm, and 12mm. The sound source is set to 70 dBA (normal road noise), 85 dBA (hazardous working environment), and 90 dBA. The different construction materials are tested in two different positions for ten readings in each position. This totals 660 readings.

Results
At the 70 dBA level, the acoustic tile absorbed an average of 11.54 dBA and had the greatest sound reduction. In comparison to the 3mm wood, which absorbed an average of 4.62 dBA and had the least sound reduction, the acoustic tile performed almost 7 dBA better. The 2" cement brick averaged 10.25 dBA and the 1½" clay brick averaged 10.08 dBA. The mirror averaged 5.68 dBA and the insulation averaged 7.57 dBA. The acoustic tile did the best, followed by the three bricks, and then the insulation. These averages remained proportional at both the 85 and 90 dBA levels.

Conclusions/Discussion
My hypothesis was not supported by the data. The acoustic tile performed the best because of the structure and composition of the materials that compose it. The wood did the poorest because the thin widths provide minimal sound reduction. Although the brick did not outperform the acoustic tile, the results were very close. This makes concrete ideal for the building material of highway sound barriers because it is cost effective, easy to assemble, and stable in various weather conditions. These results and observations have drawn my interest to new ideas of a combination of materials. Would there be greater sound reduction if acoustic tile was placed in concrete barriers along highways? Are two layers of acoustic tile twice as effective than one? These are some of the questions that I would further test.

Summary Statement
My project was to determine the effects of various construction materials on the attenuation of sound.

Help Received
Mother obtained necessary equipment.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Peter Reichert J. Reichert

Project Number

S1513

Project Title

What Is the Effect of a Liquid's Temperature on Its Index of Refraction?

Abstract

Objectives/Goals

What is the effect of a liquid#s temperature on its index of refraction? This experiment attempts to answer this central question.

Methods/Materials

To test the hypothesis, a Helium-Neon Laser was shown into a liquid at varying temperatures. Using a refractometer that held the liquid, the angle of refraction was determined and then the index of refraction was computed. A plot of temperature vs. index of refraction was generated and a trendline was fit to the data. This procedure was repeated for four different liquids.

Results

For every liquid, the results showed that as the temperature increased, the index of refraction decreased. Surprisingly, the change in the index of refraction with temperature was found to be consistent for all four liquids that were tested.

Conclusions/Discussion

It was concluded that in every case the index of refraction decreased as the temperature increased. Interesting, the rate of decrease of the index of refraction was nearly identical for all four liquids.

Summary Statement

The project investigated the correlation between a liquids temperature and the index of refraction.

Help Received

Father helped conduct experiment; Used equipment provided by California State University at Long Beach.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Jacob J. Rucker

Project Number

S1514

Project Title

Quantifying the Effect of Skyglow on the Visibility of Stars

Abstract

Objectives/Goals

Skyglow caused by excess light from urban centers obscures the visibility of stars and is an increasing problem for astronomical observations. This experiment determines whether the amount of skyglow can be predicted based upon the angle of observation and a site's distance from an urban center.

Methods/Materials

I used a digital (CCD) camera to take over 300 60-second time exposures in similar weather and moonlight conditions between September 2003 and March 2004 from sites around San Diego County at distances of 30, 45, 60, 75, 100, and 124 kilometers from the urban center and over 400 exposures between September 2005 and February 2006 at three sites 75 kilometers from the center at angles of 45, 60, 75, 90 (zenith), 105, 120, and 135 degrees. The images were downloaded and converted into bmp files. I developed a custom computer program to isolate skyglow pixel values by removing CCD noise and star pixels from the images and to compute the average intensity of the skyglow pixels for each image. Resulting intensities for each site were averaged, graphed, and compared to known functions to determine a best-fit mathematical correlation to the intensity (skyglow) as a function of a site's distance from the urban center and the angle of observation.

Results

The average intensity of the zenith images varied greatly at the eight sites, from 32.4 at 30 km from the urban center to 13.6 at 45 km, 7.1 at 60 km, 5.8 at 75 km, 3.9 at 100 km, and 3.1 at 124 km. Based upon the data, I derived an approximate formula for zenith skyglow value, "S", as a function of distance, "d": S = 2.4 X 10^2 X d^-1.9. The amount of skyglow at 60 to 75-degree angles of observation averaged up to 34% more than zenith skyglow values for the same distance and up to 15% average increase at 105 to 120 degrees.

Conclusions/Discussion

The amount of skyglow (S) decreased inversely with the distance (d) from the urban center, as approximated by the equation: S = 2.4 X 10^2 X d^-1.9 per one degree of sky, with significantly greater amounts of skyglow for non-zenith angles of observation both towards and away from the urban center. The formula reveals that observable visible light from stars remains below 50% until over 50 km from a city the size of San Diego and does not improve to 90% visibility until over 115 km from the urban center, indicating an increasing threat to astronomical observations at the nearby Mt. Laguna and Palomar Observatories.

Summary Statement

This project examines the effect of urban skyglow on the visibility of stars using computer analysis of CCD pixel data and derives a formula for skyglow as a function of a site's distance from an urban center and the angle of observation.

Help Received

Thanks to my dad for driving me out to the desert so many times in the middle of the night and for teaching me to program in C++. Thanks also to John Hoot, astronomer and computer scientist, for loaning me the Meade LPI and LX90 telescopes and teaching me about CCD astrophotography.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Matt Pistone; Andrew Tweed

Project Number

S1599

Project Title

The Effects of Radiation and Viscosity on Sonoluminescence

Abstract

Objectives/Goals

To determine the effect of exposure to radiation and the effect of viscosity on stability and consistency of single-bubble-sonoluminescence (SBSL).

Methods/Materials

Flask with transducers, circuit outputting 800VAC p-p at about 30kHz, microphone transducer attached to oscilloscope, refrigerator to maintain stable temperature, heating wire to induce bubbles, radioactive sources, acetone.

Sound was driven into the flask at frequencies near 30kHz using different viscosities and exposures to radiation. Effectiveness was measured by consistency of bubbles and symmetry of bubble frequency.

Results

Results are pending the receipt of experimental variables (sources of radiation and acetone. It is expected that radiation will detract from stability, and viscosity will add to stability, up to the point of being too thick to transmit vibrations.

Conclusions/Discussion

The sources of radiation, by adding high-energy particles to the bubbles, will likely cause turbulence. This is an issue because a successful fusion reaction would involve substantial neutron radiation, which would therefore disturb the continuing process. Viscosity will contribute a stability to the environment of the bubble and will resist deformation.

A process of combining Eigenmodes of the flask, such that the two added waves would result in beats of the previously used frequency, around 30kHz, was attempted, but the audio amp#s fuse failed during the testing. It was thought that using beats of the desired frequency, while comprised of much higher-energy waves, would allow a substantially increased energy in the center.

Summary Statement

Determining the effect radiation and viscosity has on SBSL bubbles

Help Received

Physics teacher offered suggestions and help with gathering data.