Name(s)

Julie Baker; Karen Nichols

Project Number

S1601

Project Title

Twinkle, Twinkle, Little Star, How We Wonder Where We Are?

Abstract

Objectives/Goals

This project was designed to determine how accurate, and operator friendly the navigational tools were (compared to each other) when determining latitude, and using GMT to determine longitude (part two).

Methods/Materials

Both the Sextant and Quadrant were hand constructed. The North Star was sited on the head of the quadrant and the weight was pulled by gravity, intersecting a point of an angle. When determining latitude, the sextant was set on the base of a leveled tripod. One would look through the PVC pipe to sight the North Star and the other would see the angle detected by the Carpenter#s angle. Both angle and weather were recorded. For determining longitude,the sunrise and sunset were recorded. A sunrise/sunset table was used to determine the sunrise or sunset at zero degrees longitude. The time of sunrise/sunset at zero degrees longitude was than subtracted from the observed sunrise or sunset. Each hour was multiplied by 15 degrees and each minute by .25 degrees. Finally these calculations were added together to determine longitude. In part two five locations were selected containing the same longitude as Edwards, CA. The sunrises and sunsets were recorded for multiple days to demonstrate the use of GMT in determining longitude.

Results

After taking readings of the North Star, with the quadrant and sextant, the quadrant#s readings (AVG=35.06 Degrees N) were closer to the actual latitude (35.05 Degrees N). The Sextant#s readings were accurate as well (34.74 Degrees N), but clearly not as close to the actual latitude. In Part Two of the experiment the longitudes were not as close to the actual longitude of the various locations (when demonstrating GMT).

Conclusions/Discussion

Considering the data, the quadrant is easier to operate resulting in more accurate readings. The sextant worked well, though considering the conditions of early mariners and the precision of the procedures needed, the readings were less accurate. Both navigational tools are similar, but the results show that the quadrant was easier to operate, quicker, and produced more accurate readings. After determining longitude we were within about sixty miles (or 1 degree) of Edwards, CA. For part two the results were less accurate than part one. Overall, these methods used by early Mariners could be used to find a large area, like a big city, rather than a specific house.

Summary Statement

A Navigational Study of the North Star using early Mariner Navigational Tools, and demonstrating the use of GMT (Greenwich Mean Time).

Help Received

Col. Joseph Nichols

Name(s)

Eric Casavant; Alex Marshall

Project Number

S1602

Project Title

On the Direct Detection of Dark Matter with LENS: A New Directionally Sensitive Low Energy WIMP Detector

Abstract

Objectives/Goals

Astronomical observations suggest that there is an immense amount of matter in the universe that is invisible and seemingly undetectable. This invisible matter is known as dark matter, and it has been theorized to exist for nearly a century. The WIMP (Weakly Interacting Massive Particle, also referred to as the Neutralino) is the leading candidate for the particle that constitutes the majority of dark matter density in the universe. However the WIMP has never been directly detected. This project proposes a new WIMP detector called LENS, the Low Energy Neutralino Search

Methods/Materials

The LENS detector will detect WIMPs by observing recoil and photon emission caused by WIMP-mercury nucleon collisions. This is accomplished by using a thin solid state mercury target medium sheet placed inside a highly evacuated and cooled chamber. Above the target medium is a TPC (Time Projection Chamber), and surrounding the target medium are PMTs (PhotoMultiplier Tubes). In the event of a WIMP interaction, a single mercury atom will spontaneously ionize and leave the medium. Because it is ionized, its trajectory can be tracked through the TPC. Also, due to the WIMP interaction, the recoiling ion will also emit photons, which can be observed by the PMTs.

Results

According to theoretically calculated events, LENS has the ability to bring many new limits unachievable by other methods of detecting dark matter. It has the most efficiently used target mass (the most amount of interactions per kg/day), and the lowest observable recoil energy threshold. Also, superior methods of discrimination against non WIMP recoil events have been found specifically for this detector. LENS also has the ability to view recoils with the highest resolution, and can view the energy distribution of a WIMP interaction with the highest accuracy.

Conclusions/Discussion

Dark matter has never been directly detected. This project proposes a new method to detect dark matter that uses Mercury recoils and scintillation to detect WIMP interactions and their corresponding direction. hypothetical WIMP interactions have shown promising results, with several new contributions that LENS could bring to the study of detecting dark matter.

Summary Statement

This project is on the design of a new dark matter detector.

Help Received

Graduate students attending Berkeley helped educate us on very abstract dark matter concepts (we conducted all major research at home). Physics and Math teacher verified some of our physics problems and solutions

Name(s)

Tyrone T. Chen

Project Number

S1603

Project Title

The Effect of Increased Angle Elevations on Node to Node Distances during Film Boiling

Abstract

Objectives/Goals

Since film boiling generally follows the exponential relationship of decreasing node to node distances for increasing angles of elevation, the effect of increasing the angle of elevation to 90 degrees is predicted to follow this same relationship.

Methods/Materials

A special container was created to induce film boiling on a stainless steel wire by running voltage or a current through the wire and heating the surrounding liquid. Images for every trial were captured using the high-speed camera in addition to the Redlake imaging program. Then, each node to node distance was measured using relative distance measurements as taken from the camera shot. After this process was repeated for ten trials at each of the four angles of elevation chosen, the node to node distances were averaged for each angle. This process was completed for both the 0.2mm and 0.5mm diameter wires.

Results

The results from the 0, 30, and 60 degree angles verified the results of previous research proving that for increasing angles of elevation, the average node to node distances decreases. In addition, the 90 degree angle of elevation was also seen to follow this same relationship.

Conclusions/Discussion

These successful experiments show that the vertical film boiling has smaller node to node distances than any other elevated angle, and the idea of vertical film boiling can be applied to several applications for releasing heat more efficiently. Even systems that currently use film boiling, such as in certain nuclear reactors and heaters, can be improved for greater heat release efficiency if the 90 degree angle of elevation is applied.

Summary Statement

My project involves the improvement of heat transfer through film boiling.

Help Received

Used the lab equipment at the UCLA Boiling and Heat Transfer Lab at UCLA under the supervision of Dr. Gopinath Warrier

Name(s)	**Project Number**
Jarod A. Corey	**S1604**

Project Title

Hand Warmer Performer

Abstract

Objectives/Goals

My objective is to determine if the type of glove affects the temperature of the heat emitted by the Coleman Disposable Hand Warmers. By determining the temperature of heat emitted from the Coleman Disposable Hand Warmers in the different types of gloves, you would be able to determine which type of gloves would be more feasible for the temperature outside.

Methods/Materials

An activated Coleman Disposable Hand Warmer was placed inside six different types of gloves. The Coleman Disposable Hand Warmer was allowed to fully heat up inside each glove. The temperature was recorded at certain intervals inside each glove. Each test/experiment of six different gloves was tested five times. The average temperature of each Coleman Disposable Hand Warmer was determined inside each glove and then graphed.

Results

The Coleman Disposable Hand Warmer emitted the most heat inside the deerskin leather glove with an average heat output of 32.2° C., followed by the goatskin leather glove with an average heat output of 30.0° C. The polyester knit glove came in third with an average heat output of 27.3° C. While the mechanics (synthetic leather and spandex) glove came in fourth with an average heat output of 25.7° C. trailed by the canvas cotton glove with an average heat output of 24.3° C. The Coleman Disposable Hand Warmer emitted the least amount of heat inside the acrylic knit glove with an average heat output of 21.6° C. All of the above-mentioned degrees are +/-2° C.

Conclusions/Discussion

It does appear that the type of glove affects the temperature of the heat emitted from the Coleman Disposable Hand Warmers. I found my hypothesis to be correct, based on my conclusions.

Summary Statement

To determine if the type of glove affects the temperature of the heat emitted by the Coleman Disposable Hand Warmers.

Help Received

My parents helped shake the Coleman Disposable Hand Warmers.

Name(s) Thamine Dalichaouch	**Project Number** **S1605**

Project Title

Effect of Shielding on Potentially Harmful 60 Hz Magnetic Fields

Abstract

Objectives/Goals
In last year's project, I measured the 60 Hz magnetic field emissions from various appliances found in my home. The strength of these emissions was found, in many instances, to be in excess of 5 milligauss (mG) at typical distances. Based on epidemiological studies, prolonged exposure to 60 Hz magnetic fields in excess of 5 mG should be avoided because of potential health effects, such childhood cancer. This project investigates the following: is it possible to reduce exposure to Extremely Low Frequency (ELF) magnetic fields emitted by electrical household appliances by appropriate shielding?

Methods/Materials
To answer this question, I performed high-resolution measurements of the spatial distribution of 60 Hz magnetic fields associated with shielded home appliances using different shielding configurations (i.e., shape, number of layers, etc) and materials.

Results
The results show that materials with high magnetic permeability are ideal materials for shielding ELF magnetic fields and that, even with moderate shielding, the spatial boundary around the appliance where a subject is considered exposed can be significantly reduced.

Conclusions/Discussion
Candidates such as mu metal alloys (80% Ni, 20% Fe) or low carbon steel seem to be good options for designing a new-generation of household appliances with low 60 Hz magnetic emissions. These materials are available in thin foils that can easily produce snug fitting shapes around an appliance to serve as a magnetic barrier. However, a more affordable solution may be to use magnetic paint that can be easily applied on plastic and other surfaces.

Summary Statement

This project investigates ways to reduce 60 Hz magnetic emissions from household appliances in order to reduce human exposure to such fields which have been linked to potential health effects.

Help Received

Father supervised measurements and helped type report.

Ap2/07

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
Lauren Dickinson; Amanda Tran

Project Number

S1606

Project Title
Glowing Undergoing: The Phosphorescent Phenomenon

Abstract

Objectives/Goals
The objective of our project is to determine if different wavelenghts of UV light will affect the overall quality of light emitted by the minerals, such as the decay of light over time, intensity of light emittance, and the gradualness of decay.

Methods/Materials
We used the minerals Calcite, Colemanite, Gypsum, Willemite, and Celestite. We used a phototransistor connected onto a rubber stopper to measure the light emitted from the minerals. This phototransistor was connected to an oscilloscope through a circuit which used alligator clips, a resistor, and probes. The minerals were crushed and measured in a cuvette and then placed inside a small plastic container that was secured in a black photobox. Above the box we placed a 3UV lamp that would expose the minerals to shortwave(254 nm), midrange(302 nm), and longwave UV(365 nm).

Results
The highest intitial phosphorescence by the minerals in longwave was 9.12 volts (Celestite), in midrange was 4.49 volts (Colemanite), and in shortwave 2.07 volts (Celestite).

Conclusions/Discussion
According to the average graphs of the decays of the minerals, longwave UV light resulted in the brightest emittance and a very even and gradual decay.   Midrange UV light resulted in dim but long lasting phosphorescence. Shortwave UV light gave off a bright phosphorescence at the beginning, showed a sudden drop in intensity, and then the light level reached ground state pretty quickly.
An application to consider might be phosphorescent or flourescent substances in highway paint. Another practical but harder to achieve application would be to find a way to use phophorescence as a new natural light source. This would greatly improve the global warming and pollution situations on our planet. As a new light source, phosphorescence would be beneficial by decreasing depletion of natural resources (i.e. coal and oil) and heat and combustion aren#t results of phosphorescence unlike most light soucres.

Summary Statement
In our project we set out to determine the effect of different UV wavelengths on mineral phosphorescence using an oscilloscope to acquire the graph of light decay.

Help Received
Mr. Zimmerman taught us how to use the oscilloscope and suggested means of collecting data; Ms. Black opened the lab for our use and gave us occasional assistance with oscilloscope; Ms. Sharon Cisneros from Minresco company supplied us with minerals and a UV lamp; Mr. Lynn helped us with the oscilloscope.

Name(s)

Kyle R. Dwyier

Project Number

S1607

Project Title

Steam Whistles

Abstract

Objectives/Goals

I built a high efficiency, low-pressure whistle out of a piece of four-inch abs plastic pipe. I was trying to match the same output as a turn of the century steam whistle that could be found on an old train, and can be heard up to two miles away.

Methods/Materials

materials: -26 inches of 4-inch abs plastic pipe; -Abs cement; -3/8 inch all thread; -4 3/8 inch washers and nuts; -1/4 inch all thread; -1/4-inch nut; -5 1/4 inch washer and nut; -4-inch o-ring; -2 cans of Krylon paint.

procedure: -I found the pipe I#d me needing I did all of the mathematical calculations; -I did all of the mathematical calculations; -I cut the pipe into 3 pieces: one was 17 inches and the other two were 4 and a half each; -I measured out the space for the air hole; -I cut out the air hole; -I put the tapered edge on the top edge of the air hole; -I machined the circle that makes the languid plate; -I cut out the slot in the languid plate; -I machined the circles that make the base plate and top; -I drilled the holes necessary in the base plate; -I machined the grooves into the base plate; -I cemented the languid plate in place; -I cemented the base plate in place; -I cleaned off the outer tube; -I painted the whistle; -I cemented the top plate in place.

Results

I accomplished what i intended to create. My whistle was able to be heard from a little more than 2 miles away. I am very satisfied with all of my findings.

Conclusions/Discussion

In the end, I have learned a lot throughout this project. I accept my hypothesis, because I made a high efficiency whistle that runs at low pressure, that sounds like an old steam whistle. It can also, be heard from just over 2 miles away. All in all, this was a great project, and my predictions, though at the beginning of the project seemed a little farfetched, seem to be 100% accurate.

Summary Statement

I made a high efficiency, low preassure air whistle.

Help Received

Mike Dwyier - Mentor ...my dad / RIchard J. Weisenberger - Mentor...Acoustic engineer

Name(s)	Project Number
Carlyn Girard; Lucas Prokopiak	**S1608**

Project Title

Maximizing Thermal Efficiency: Darfur Stoves

Abstract

Objectives/Goals

The focus of this project is the wood fuel needs of refugee camps in the Darfur region of Sudan. We added insulation to a basic chimney style metal cooking stove to create an original design that could be assembled using recycled materials. We hypothesized that we could design a cooking system significantly more efficient than traditional methods that would reduce the wood fuel demands of the refugee camps. Reducing wood consumption in the camps would reduce the time women spend looking for wood outside of established security zones.

Methods/Materials

We constructed two metal stoves and tested their thermal efficiency against the traditional three stone fire used in refugee camps in Darfur and around the world. The metal stove design was patterned loosely from a stove developed at the University of California Berkeley for use in Darfur. We surrounded one of the stoves with a two-inch layer of wood ash insulation. The two metal stoves were made out of completely recycled metal. We also evaluated the use of insulation systems to cook with retained heat.

Results

Our insulated stove had an average thermal efficiency of 32.4%, more than quadruple the 7.9% average efficiency of the three stone fire. The non-insulated metal stove had an average efficiency of 28.1%. The metal stoves also reduced the time necessary to reach boiling point. Cooking with retained heat further decreased the wood needed to satisfy cooking demands.

Conclusions/Discussion

We successfully demonstrated an improved cooking stove design that is significantly more efficient than the current cooking methods used in the Darfur refugee camps. The stove can be assembled in the camps from low-cost materials available to refugees. The use of these stoves on a wide-spread basis would decrease fuel wood consumption and the associated hazards women face when gathering wood away from the refugee camps.

Summary Statement

We designed and tested metal cook stoves with fuel-efficient properties that could potentially benefit refugees in the Darfur region of Sudan.

Help Received

Received advice and equipment from Mr. Earl Peters. Father helped with stove construction.

Name(s)	Project Number
Tom J. Hiel	**S1609**

Project Title

Heat Transfer in Hydrogen Fuel Storage Tank Insulation

Abstract

Objectives/Goals
Hydrogen Fuel cell vehicles are currently the more environmentally friendly option to replace the present-day gasoline powered cars. The hydrogen used to power the vehicles must be kept at cool temperatures inside the fuel tank. In this experiment, I used insulating foam and determined how adding layers affected the rate at which heat was transferred to the tank.

Methods/Materials
For the experiment, I used a metal fuel tank with three thermocouples attached that I put in the freezer. One thermocouple measured the temperature inside the tank. One measured the temperature on the outside surface of the tank. The third thermocouple measured the temperature on the outside of the insulation being tested. I removed the tank from the freezer let it sit at room temperature. The thermocouples were attached to the computer which records the slow heating of the tank.

Results
The results from 1, 2, 3 and no layers were analyzed. The correlation between the number of layers and time to reach room temperature was determined. In addition, an exponential was used to fit the heating curves and the time constant was determined for the different layers of materials.

Conclusions/Discussion
The most effective insulation was determined by the longest time it took for the hydrogen tank to return to room temperature. I will analyze the curves created by the graphs. All my data has been described and graphs have been created showing my findings. In the future, I hope to expand the project and use different insulating materials as well as examine the cost to determine which insulation is the most effective.

Summary Statement

In this experiment, I used insulating foam and determined how adding layers affected the rate at which heat was transferred to the tank.

Help Received

I would like to thank my parents for their help and support in this project. Without them I would not have had the equipment to complete my experiment.

Name(s)	Project Number
Simon D. Jacobs	**S1610**

Project Title

Do Different Frequencies of Light Contain Different Amounts of Energy?

Abstract

Objectives/Goals
The experiment "Do different frequencies of light contain different amounts of energy?" was conducted to discover whether higher frequencies of visible light, such as blue light, transfer greater, measurable amounts of energy to other substances. Although it's true that higher frequencies carry greater amounts of energy than lower frequencies, it is not widely known how wide the difference is between colors as close in the spectrum as red, green, and blue.

Methods/Materials
The experimental apparatus included an LED capable of creating three colors, red, green, and blue, by changing the circuit's construction. The light was directed at a drop of isopropyl alcohol. The time it took for the alcohol to evaporate would represent the relative power of each color of light. Each color was tested 25 times.

Results
Using red light, the alcohol evaporated after an average of 1:18.74. It evaporated in 1:06.39 under green, and 0:48.48 using blue. According to the t-test, the differences between these results were all statistically significant.

Conclusions/Discussion
Blue light, which is a higher frequency of light, transfers more energy to other substances than light of lower frequencies, such as red and green.

Summary Statement

Blue light transfers more energy to a drop of alcohol than red or green, as evidenced by the amount of time it takes for a drop of alcohol to evaporate.

Help Received

People at electronics store helped find LED and explained how to hook up circuit; Father helped figure out how to measure heat transfer without an appropriate thermometer, helped connect different components of the circuit, explained t-test, and helped write application; Teachers helped with the

Name(s)

Seung Mi Jung

Project Number

S1611

Project Title

A Test of Spectral Predictions of the Bohr Theory

Abstract

Objectives/Goals
To determine the success of the Bohr model of the atom predicting the emission spectrum produced by atoms of various elements and to find an empirical value for the Rydberg constant for atoms that the model successfully describes.

Methods/Materials
A two-arm spectrometer is used to measure the wavelengths of the spectral lines produced by several elements when an electric current is passed through them. A Matlab program is used to generate theoretical values for the brightest spectral lines of each element according to the Bohr Theory. The brightest lines predicted in the visible spectrum are then compared with those observed. For hydrogen, a least squares fit of the observed wavelengths to the Rydberg equation reveals an empirical value of the Rydberg constant.

Results
The observed wavelengths of the spectral lines of hydrogen are in good agreement with predictions of the Bohr Theory, while those of the other elements tested vary widely from the theoretical values. The value of the Rydberg constant deduced from the hydrogen spectrum is in good agreement with a theoretical value calculated using known constants of nature.

Conclusions/Discussion
The Bohr model provides an inaccurate or incomplete description of the structure of atoms of elements heavier than hydrogen, and its failure seems to stem from the presence of multiple electrons in these atoms.

Summary Statement

This project is to test the ability of an atomic model to account for the emission spectra of different atoms.

Help Received

Name(s)	Project Number
Elise A. Kimball	**S1612**

Project Title

Fast Fourier Transform Algorithm Analysis of the A 440 Frequency to Determine Violin Tone Quality

Abstract

Objectives/Goals
Fifty violins were tested to determine which group had the best tone through LabPro graphing software.

Methods/Materials
The variables were price ($500-$1,000, $4,000-$12,000, and over $20,000), age (less than 50 years, 50-100 years, and over 100 years), and country of origin (USA, China, Germany, Italy, and France).

Results
For price the meduim and high priced violins had the best quality tone. The old violins had the best tone, and the French vioins produced the best quality tone.

Summary Statement

Violin sound quality was tested using fast fourier transform algorithm computer analysis.

Help Received

Dad helped record data on computer. Mom helped with the board. School supplied LabPro graphing software and mic. Violins provided by Robert Cauer studio in Los Angeles.

Name(s)	Project Number
Kory Kindle; Kevin Renteria	**S1613**

Project Title

Light and Brightness

Abstract

Objectives/Goals

The purpose of this experiment is to determine which light bulb; incandescent, halogen, or fluorescent, provides the most light or brightness with the same amount of wattage.

Methods/Materials

Step 1: Screw in the light bulb being tested.
Step 2: Turn the light on and hold the homemade brightness meter 9 ½ inches away
Step 3: Use the light spectrum tool to measure the wavelength of the light.
The Light Spectrum is the portion of the electromagnetic spectrum that can be detected by the human eye. Enables humans to see wavelengths from 400-700nm
Step 4: Record the color given off by the light

Halogen light bulb 25-watt
Fluorescent light bulb 25-watt
Incandescent Light Bulb 25 watt
Light spectrum
Homemade Brightness meter

Results

Within the bulbs and the brightness, each light bulb produced a different color and brightness. The incandescent produced a tannish color causing it to be not very bright. The halogen gave off a white/yellowish color that was fairly descent but still didn't give off that much light. The flourescent light bulb produced a white light which is almost impossible to look at when it is glowing at its fullest brightness.

Conclusions/Discussion

Based on our experiment, we discovered that our hypothesis was incorrect.
The fluorescent bulb provides the most light and lasts the longest. It gives off a white light, which is more visible than the yellow and tan light produced by the halogen and incandescent light bulbs. The halogen light bulb,
However, its very small and convenient, but is a hassle to use due to many cautions. The fluorescent bulb helps saves energy throughout the environment by generating the most light; it has the greatest life span of a bulb and is shatterproof

Summary Statement

We tested the brightness and color of 3 different kinds of light bulbs with the same amount of watts.

Help Received

No help, all student work

Name(s)	Project Number
Jonathan E. Lee	**S1614**

Project Title

Centripetal Acceleration of an Object in Circular Motion

Abstract

Objectives/Goals
This project will demonstrate the affects of centripetal force has on an object and the effects that Newton#s three laws on motions has on an object moving in a circular motion. I will conduct several experiments to measure the centripetal force generated by varying the mass and radius of the orbiting object, and compare this value with the calculated amount of forces that should have be created. I will also show the effects of centripetal forces in two visual demonstrations

Methods/Materials
Centripetal Force Apparatus: Used a digital tachometer to measure the rotation speed of the rotating mass and compare it to the values for centripetal force determined by using a weight set to move the mass the same distance. Materials Centripetal Force Apparatus, Digital Tachometer, 12-volt motor, Variable Motor controller, Rule

Centripetal Force Apparatus II: Determine the affect of changing the mass of the orbiting object to centripetal force. Materials: Wooden dowel, slotted weight set, Steel fishing leader line, assorted lead fishing weights and stopwatch

Demonstration #1: This demonstration will show what centripetal force will do to water in a glass as it is traveling in a circular motion. Materials: Wooden Planks, rope, Plastic Cup, Water

Demonstration #2: This demonstration will show the centripetal force acting on a car as it travels through a curve. Materials: wooden planks, clear plastic, aluminum rod, fender washers, sprngs, screws, nuts.

Results
Tables, charts and photographs to support Newton's three laws of motion.

Conclusions/Discussion
Centripetal Force Apparatus: Changes in the orbiting radius or mass of the orbiting object a affect on a rotational period. Shorting the radius or decreassing the mass decreased the roational period or RPM.

Demonstrations: The moving vechicle demonstration showed to force acting on a mass as the car was making a turn. The force always pushed away from the center of the turn. With the water demonstration, as it was swung, it creates centrifugal force, which pushes the water

Summary Statement
Centripetal Acceleration of an Object in Circular Motion

Help Received
Teacher (John Shirajian), mother and father.

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)	Project Number
Alekzandir Morton; Manutej Mulaveesala; Thomas Travagli	**S1615**

Project Title

A Galaxy Ablaze from Afar: Spectral Energy Observations of S5 0716+714

Abstract

Objectives/Goals
The goal of this projects was to construct a Spectral Energy Distribution (SED) diagram of blazar S5 0716+714 using images from the Spitzer Space Telescope, ground based optical telescopes, and a radio telescope. Two cameras on the Spitzer Space Telescope were used: the Multiband Imaging Photometer for Spitzer (MIPS) and the Infrared Array Camera (IRAC). Once the SED was made, a portion of the radiation was modeled and analyzed.

Methods/Materials
Before the SED could be constructed, light curves were needed to confirm that the target did not significantly change between the two Spitzer observations. To do this, we needed to reduce all of the optical ground based images to plot the magnitude, or brightness, over time. Imaging software was used to find the brightness of the target for a particular picture, which was then graphed and modeled compared to standard stars in the image using graphical analysis software. Once the light curves were constructed, the SED data points were then reduced. Spitzer images were reduced at the Spitzer Science Center on the Cal Tech campus with the guidance of a professional astrophysicist.

Results
An unusual bump was seen in the SED located in the MIPS infrared data points. This bump could be attributed to added heat in addition to the synchrotron radiation. This bump was mathematically modeled, which was used to calculate the approximate temperature of the added heat. The temperatures were inconsistent due to different suggested redshifts, which could only be estimated.

Conclusions/Discussion
Two different explanations can be given for the added heat seen in the MIPS data points on the SED. First, it could be heat coming from the torus surrounding the black hole in the blazar. Second, it could be heat coming from the surrounding stars in the host galaxy. To determine which of these explanations is correct, a more accurate model of the bump is needed. To make the model more accurate, more data points are needed. This can be accomplished through a second use of the MIPS camera on Spitzer, which would also allow us to determine whether the bump is consistent with mutiple observations. A Proposal is being written to use the MIPS camera again, as well as the Infrared Spectrometer (IRS) to determine a more accurate redshift, allowing us to find a more precise temperature for the bump.

Summary Statement

The Spitzer Infrared Space Telescope and ground based telescopes were used to take images of a galaxy with a black hole at its center, which were graphed to determine the amount of energy distributed over the wavelengths of light.

Help Received

Jeff Adkins wrote proposal to use Spitzer; Dr. Mark Lacy instructed us on how to reduce Spitzer images; Steve Rapp contributed the radio data point used on the SED; Frank Pino, Vivian Hoette, Mike Harms, Jerome Hudson contributed images of the target

Name(s)
　　Claudia E. Osuna

Project Number

S1616

Project Title
Heat Absorption in Floring Materials

Abstract

Objectives/Goals
　　Purpose: The purpose of my project is to determine which type of flooring material (carpet, wood, linoleum, ceramic tiles, or rock flooring) can hold and keep the most amount of heat inside a sun room addition to a house.

Methods/Materials
　　Procedure:
1) Tape two thermometers to the inside top of the sun room model
2) Place two thermometers on the bottom of the sun room model
3) Place one of the flooring materials inside of the sun room model
4) Put the sun room model about one foot away from the sun lamp and turn the sun lamp on
5) Leave the sun lamp on for an hour, then turn it off
6) At this point, record the temperatures of all four of the thermometers onto a chart
7) Wait another hour and then record all of the temperatures again
8) Repeat steps 1-7 for each of the different flooring materials at least ten times
9) Compare all of your data to find out results

Materials:　1) a model of a sun room addition to a house; 2) four thermometers; 3) sun lamp (or heat lamp); 4) carpet; 5) rocks; 6) linoleum; 7) ceramic tiles; 8) wood.

Results
　　For my results I found out that the tile held the most amount of heat, then the wood, then the linoleum, then the carpet, then the rocks.

Conclusions/Discussion
　　The carpet was not the one that held the most amount of heat, therefore my hypothesis was incorrect. The ceramic tiles were the ones that held the most amount of heat. To improve my project there are many things that I would do. First of all, I would test a couple more different types of flooring materials. I would also test each of the flooring materials several more times. Finally, I would test to see what color of flooring material holds the most amount of heat.

Summary Statement
　　The purpose of my project is to find out which type of floring material can absorb and keep the most amount of heat in a certian period of time.

Help Received
　　Dad helped use power tools to build model sun room addition

Name(s)	Project Number
Natalya D. Rodriguez	**S1617**

Project Title

The Effect of Playing Different Notes on the Duration of the Sympathetic Vibrations of a C2 String of a Piano

Abstract

Objectives/Goals
The objective of this experiment was to learn how playing C,E, and B notes affects the duration of the sympathetic vibrations on the C2 string of a piano.

Methods/Materials
Materials: Baby grand piano, stop watch, writing utensil, composition notebook
Method:
- The C2 key was pressed down slowly and gently until the damper was raised. The key was held down until after the stopwatch was stopped.
- #3, 2, 1, go!# was counted down. On #Go!#, a loud, short note was played on the C3 key.
- The timer was started by the assistant on #Go!#
- The sympathetic vibrations on the C2 string were listened for. As soon as they were inaudible, #Stop!# was said, and the stopwatch was stopped by the assistant.
- The time was recorded in a composition notebook.
- The previous steps were repeated until 10 times were recorded for C3.
- The previous steps were repeated playing the other test notes (C4, C5, C6, E2, E3, E4, E5, E6, B2, B3, B4, B5) instead of C3. Each note was tested 10 times.

Results
Overall, the C notes produced sympathetic vibrations on the C2 string with an average duration of 19.05 seconds. The E notes produced sympathetic vibrations lasting 19.15 seconds on average, and the B notes produced sympathetic vibrations with an average duration of 14.45 seconds.

Conclusions/Discussion
Notes that share more resonant frequencies with a resonant body (i.e., the C2 string) tend to produce longer lasting sympathetic vibrations than those that have fewer harmonics in common.

Summary Statement

This project explores the connection between the number of resonant frequencies two resonant bodies share and the duration of sympathetic vibrations produced on those bodies.

Help Received

Name(s)

Nilesh Tripuraneni

Project Number

S1618

Project Title

On Propulsive Leidenfrost Phenomena: Exploring Theory, Experiment, and Applications

Abstract

Objectives/Goals

The Leidenfrost phenomenon occurs when a liquid in contact with a sufficiently hot mass produces an insulating vapor layer which supports the liquid itself. However the presence of asymmetrical surface geometries has been recently shown to influence the vapor flow, resulting in a net force being exerted on the liquid. A series of theoretical developments and experiments were formulated to characterize and explain this novel behavior, in addition to investigating its heat transfer characteristics.

Methods/Materials

To geometrically characterize the vapor flow domain a DSLR camera with a self-constructed Fourier optics system was used to obtain images of the Leidenfrost droplets. The Fourier optics system consisted of a He-Ne laser adjunct to a 100X objective lens and spatial filter, allowing the uniform expansion of light for projection. These images were mathematically analyzed using MATLAB to approximate the height of the vapor layer. A similar approach was used to determine the pressure gradient based on extrapolations from local droplet curvatures.These values were then meshed with a self-derived parallel-plate slip flow model.

A mathematical model describing heat flux within the substrate and vapor layer was developed based on the solution to a specific case of the 3-D heat equation. It was found that temperature could be effectively simplified to vary as the modulus of its 3-D position with respect to the droplet. In conjunction, fine-wire thermocouples and computer-assisted data collection were used to experimentally corroborate theoretical temperature distributions.

Results

It was found the heat transfer coefficient of the Leidenfrost droplets was a significant 611 W/m2 K. In addition the mathematical modifications analyzing flow in the slip regime, which takes into account rarefaction had much less deviation from experimentally observed value than those that neglected rarefaction.

Conclusions/Discussion

The adaptation of the Navier-Stokes equations to account for micro-scale rarefaction effects led to better agreement between experimental and theoretical predictions of heat transfer. In addition, some of the unexpected results such as the high heat transfer coefficient can be explained by the micro-scale phenomena. Leidenfrost systems offer a natural manifestation of #micro-channels# which may lead to their usage in novel, self-actuated, heat-dissipators requiring no sensors, moving parts or pumps.

Summary Statement

My project aims to investigate the mechanisms and applications of relatively unexplored propulsive Leidenfrost phenomena

Name(s)

Geoffrey H. Woo

Project Title

Dynamics of Surface Plasmon Propagation on Nanoparticle Arrays

Abstract

Objectives/Goals
The paper characterizes the behavior of localized surface plasmon polariton (LSPP) propagation on two-dimensional metal nanoparticle arrays. As excitations of surface electrons on metal nanoparticles, surface plasmons can be propagated by Coulomb interactions between nanoparticles. Plasmonics has been proposed as a superior approach for data transmission and processing by synthesizing the advantages of modern optics and electronics. The chief objective of this study is to describe and define the basic dynamics of LSPP.

Methods/Materials
Previous theoretical studies for LSPP dynamics have been limited by the expensive computational cost of solving the full set of Maxwell's equations. In this study, a novel quantum approach based on quantum scattering theory and the exciton model for excitations is used. We develop and run algorithms in Fortran, Matlab and Mathematica to computationally model and analyze the LSPP propagation. Focusing on the "optical" behavior of plasmon propagation, the study simulates plasmon propagation on arrays of nanoparticles of two disparate regions of densities.

Results
Results describe an analogue to Snell's Law for classical optics for plasmonics, relating the ratio of nanoparticle density with the angles of reflection and refraction off the interface between the two regions of nanoparticles. A second order polynomial relation is also found to describe the probability of transmittance through the interface between two different nanoparticle arrays with the magnitude of the initial momentums of the LSPP.

Conclusions/Discussion
The study add specific understanding behind the dynamics of surface plasmon propagation. The results show that plasmonics generally follows dynamics defined by classical optics in the case of reflection and refraction angles. However, results describe exotic behavior for transmissions of plasmons through the interface between media. The study may contribute to the development of new, exotic materials and devices taking advantage of the unique properties of plasmonics.

Summary Statement

Using a quantum approach, the project describes the analagous "optical" dynamics of surface plasmon propagation on metal nanoparticle arrays.

Help Received

Learned about subject at UCLA Chemistry Department under supervision of Mr. Kenneth Lopata

Name(s)

Shiri Yadlin

Project Number

S1620

Project Title

The Effect of Combining Organic Compounds with Differing Numbers of Hydroxyl Groups on Each Mixture's Viscosity

Abstract

Objectives/Goals
The purpose of the experiment was to discover the relationship between the viscosity of a pure substance and the viscosity of a mixture containing that substance.

Methods/Materials
1) Ball-drop apparatus constructed
2) Sphere massed
3) Radius of sphere measured
4) Apparatus tube filled with 250 mL glycerin
5) Sphere was dropped to fall through glycerin, a distance of 50 cm
6) Time taken for ball to drop recorded
7) Liquid emptied from tube into bowl
8) Tube refilled and process repeated until 10 values were recorded
9) Instruments cleaned thoroughly
10) Process repeated for ethylene glycol and propanol
11) 125 mL Glycerin was mixed with 125 mL ethylene glycol
12) Mixture was poured into the apparatus
13) Same test conducted to obtain 10 values for mixture viscosity
14) Process repeated for ethylene glycol/propanol mixture and propanol/glycerin mixture (all mixtures were 125 mL: 125 mL)
15) All instruments cleaned and dried
16) Calculations conducted to determine viscosity values

Results
It was determined that the mean value for viscosity of propanol was 4.51 P. The calculations for ethylene glycol showed a mean of 8.065 P. For glycerin, the calculated viscosity had a mean of 253.7 P. The ethylene glycol-glycerin mixture had viscosity of 21.67 P, while glycerin-propanol mixture#s viscosity values was calculated to be 15.31 P. Finally, the mean viscosity of the propanol-ethylene glycol mixture was 6.111 P, ranging from 5.530 P to 6.530 P.

Conclusions/Discussion
It was found that the propanol was the least viscous liquid followed fairly closely by ethylene glycol and with glycerin being the most viscous by far. Viscosities of the mixtures of the liquids, contrary to the hypothesis, were found not to be equal to the weighted average of the viscosities of the two liquids

Summary Statement

This project investigated the relationship between the viscosity of a pure substance and the viscosity of a mixture of multiple similar substances containing the original substance.

Help Received

Mentored by science teacher