Abstract: Science and Engineering Fair of Houston

1359

String theory

Michelle Borche
Esther Akinsanmi
Araoluwa Akinsanmi
Harmony South District

Category

Physics and Astronomy

This project investigates the relationship between the pattern of string vibrations and the corresponding frequencies, aiming to illustrate how different vibration modes and tension adjustments affect the observed pitch. Using a rubber band or stretched string anchored on a rigid frame, we conducted a series of experiments to observe changes in vibration patterns. The materials included a rubber band or stretched string, a rigid frame, scissors, and a ruler to measure distances. We varied the tension of the string by adjusting how tightly it was pulled between the anchor points. By plucking the string at different points and with varying force, we observed the resulting vibration modes. Additionally, we altered the string's tension to investigate how it influenced the frequency of vibrations. The observations indicated that changes in tension and plucking position significantly affected the vibration patterns and frequencies. Higher tension resulted in higher frequency vibrations, while different plucking points produced distinct vibration modes. These results demonstrate that the pattern of string vibrations is highly dependent on both tension and the point of excitation. This finding can be used to explain how vibration patterns at different frequencies correspond to various types of particles, providing valuable insights into the principles of wave mechanics.

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☐ vertebrate animals ☐ microorganisms ☐ rDNA ☐ tissue

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Abstract: Science and Engineering Fair of Houston

1360

Frozen Vs. Normal Baseballs

jagger cruz
Grayson Strain
Central Middle School

Category

Physics and Astronomy

The purpose of this experiment is to help baseball players determine what the best temperature to play in is. The procedure we went on was by taking the balls and putting them in the sunlight and in the freezer. The most important thing we found was that warm baseball went faster. and our conclusin is that playing in the heat is better for pitching velocity.

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Abstract: Science and Engineering Fair of Houston

1361

Climate Change and Baseball

Josh Jones
Central Middle School

Category

Physics and Astronomy

As temperatures rise baseball pitchers are throwing faster. This could change how baseball is played. Millions of people watch baseball and might find this interesting. I was trying to find out if baseballs pitches go faster in warmer weather. Faster balls could be harder to hit and cause more home runs. I measured the velocity of pitches at different games. I recorded the first 10 pitches that the pitchers pitched. I recorded the temperature to see if the pitch velocity changed when the temperature changed. There were 4 pitchers that supported my hypothesis out of about 7 pitchers. The overall pitch speed averages were higher from games with cooler temperatures. The hypothesis was weakly supported with some pitchers but not supported with the game averages. I had no trouble with my controlled variables. The weather did get a little cooler for some of the games. It was not difficult to find the results but there was not a clear answer. I said the ball would go faster in warmer temperatures which was true with some pitchers, but it went slower overall. I could do this for a longer period of time or with more pitchers for better results. The warmer temperatures didn't make the pitches faster overall. My hypothesis was not supported by average game pitch speed. It was supported by some pitchers. It could be also that the hotter temperatures make the pitchers more tired so they don't throw as hard.

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Abstract: Science and Engineering Fair of Houston

1362

The Science of Sound

Adelynn Valora
Conroe ISD /McCullough Junior High

Category

Physics and Astronomy

Sound travels by compressing and decompressing air particles many times per second. If the sound source is farther away, then the sound will have less energy. This makes sense because sound has energy, and it transfers and diminishes as it moves. Although sound can travel long distances, it can dissipate over time due to distance, pitch, and surroundings, the independent variables for this project. The speaker played one out of three pitches at a constant volume and remained in one spot, and the distances remained the same. Two rooms, a gym with wood floors and echoing walls, and a quiet chapel with soft chairs and carpets affected the dependent variable; how much energy the sound had after all the independent variables had been taken into account. The expectation was that the sound would dissipate more in the chapel. Three pitches per room were measured at various distances marked with tape three times each. There were some outliers in both rooms, either much quieter or louder than expected, especially the gym. Lastly, the measurement tool recorded every decibel level from the back to the front of the room, showing interesting data on how sound bounced off walls and/or was obstructed. Some areas of the room had very strong decibel levels while some were very quiet. The many trials were easily averaged and proved that the overall trend was that the volume decreased the farther the measurement tool was from the source, proving the hypothesis correct.

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Abstract: Science and Engineering Fair of Houston

1363

Relationship of Temperature and Magnet Strength

Aiden Lee
The Woodlands Methodist School - MS

Category

Physics and Astronomy

The purpose for this experiment was to show that there was a correlation between the temperature of the magnet and how it preformed. In this experiment the magnet was placed through various temperatures to put to the test if the temperature of the magnet really affects the strength of it. The most important result I found is that there was a clear correlation between the independent and the dependent variable. Based on the results of this experiment, the hypothesis was proven correct. The magnet that was placed in the freezer had a stronger magnetic field than the magnet that was placed in boiling water. Using the pocket scale, it allowed one to infer that when a magnet is exposed to the cold, its magnetic properties become stronger.Based on the obtained r- squared value there appears to be a clear correlation between the temperature of the magnetic and its corresponding strength. If this experiment were to be completed again, the thing that would change is the number of testing temperatures.

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Abstract: Science and Engineering Fair of Houston

1364

UV Radiation VS. Surface and Air Temperature

Isabella Mcfarland
Houston ISD /BCM Academy at James D Ryan - MS

Category

Physics and Astronomy

UV Radiation has many concerns including, skin damage, skin cancer, eye damage, environmental impacts, and many more. The effects of ultraviolet radiation on air and surface temperatures have critical implications for material performance and climate studies. I am interested in this topic because it is important to other fields of science, for example, biology and medicine, physics and chemistry, and environmental sciences. This project investigates how UV radiation impacts the air and surface temperatures of various materials over a 48 hour period. Using an enclosed setup, air and surface temperatures were measured under direct UV exposure at specific times for the materials I used such as glass, grass, and asphalt. My results have shown that the different materials did in fact increase the air and surface temperatures by being under the UV light source, but the material that increased the most was asphalt.

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Abstract: Science and Engineering Fair of Houston

1365

Initial height on projectile motion

Sebastian Herrera
Houston ISD /BCM Biotech Academy at Rusk - MS

Category

Physics and Astronomy

Projectile motion uses several variables to predict where the projectile is and travels, such as initial height and angle. Because of the not very known calculations in finding the best projectile motion variables for distance, people normally guess. Using a simple method of changing both angles and initial launching height, I launched several consistent projectiles at three different heights and at five different angles, testing them four times each. The major findings from my research have proven that height is a crucial factor for projectile motion, with an increase of launching height leading to an increase in distance. However, not all projectiles at all angles are affected by initial height equally. Projectiles launched at angles closer to zero went further than projectiles launched at ninety at initial heights above zero. This helps improve placement and efficiency of launching a projectile.

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Abstract: Science and Engineering Fair of Houston

1366

Energy In The Air?

Samuel Galaviz
Weis Middle School

Category

Physics and Astronomy

My project was about the Tesla coil and how it is useful for lighting because it is wireless electricity or energy. In case of a power outage the Tesla coil can provide lighting or energy that can be useful for people who don't have enough money to buy a generator. This technology is also used in things such as an MRI (magnetic resonance imaging) this is also applicable to teach students about concepts about energy and magnetism.

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Abstract: Science and Engineering Fair of Houston

1367

What Materials Fly Best?

Carlos Zarate
Roberson - MS

Category

Physics and Astronomy

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Abstract: Science and Engineering Fair of Houston

1368

Leveraging Computational Fluid Dynamics for Real-Time Pipe Diagnostics Through Reynolds Number Analysis

Arsh Kudariya
Beckendorff Junior High school

Category

Physics and Astronomy

A continuous water supply is essential to quotidian life, making the proactive detection of pipe issues such as blockages, leaks, and corrosion crucial in maintaining the efficiency and safety of fluid transport systems. This study investigates how changes in the Reynolds number (Re), a dimensionless parameter representing turbulence, can reveal such issues. Re is influenced by fluid velocity, pipe diameter, and fluid properties and typically remains within predictable ranges under normal conditions. Abnormalities like blockages, leaks, or corrosion cause deviations in Re, which can serve as diagnostic indicators. Using computational fluid dynamics simulations, various pipe problems were modeled to examine their effects on Re. Partial blockages sharply increased Re due to restricted flow and elevated velocity in narrowed regions, inducing higher than average Re. Leaks caused localized fluctuations in turbulence, increasing near the leak site due to escaping fluid and decreasing downstream from reduced flow. Corrosion, characterized by surface roughness and irregularities, led to complex Re variations, gradually increasing turbulence and resistance across the pipe. Statistical analysis confirmed a strong correlation ($p < 0.01$) between Re changes and specific pipe issues, enabling accurate differentiation among blockages, leaks, and corrosion. These findings were validated against experimental data, demonstrating the model's predictive accuracy and potential for real-time diagnostics. This research highlights the utility of Re analysis as a robust and efficient tool for identifying pipe problems, offering improvements over traditional invasive inspection methods. The expansion of this model holds potential for broad application, from residential to industrial and municipal systems.

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Abstract: Science and Engineering Fair of Houston

1369

What Kind of Fruit Produces the Most Electricity?

Shaoting Gao
Fort Bend ISD /Fort Settlement Middle School

Category

Physics and Astronomy

This experiment was performed to determine which citrus fruit can produce the most electricity using redox (oxidation-reduction) reactions and the relationship between the electric current produced by a substance and the pH value of a substance. Experiments were performed to find the acidity and pH value of the juices of lemons, limes, oranges, and grapefruits, as well as water, and a baking soda solution. A copper and zinc electrode were wired to an ammeter and dipped in the liquids to determine the electric current produced by the liquid by redox reactions. Then, pH indicator strips were dipped in the liquids to determine the pH value. The results show that the current produced by lemons, limes, oranges, grapefruits, water, and baking soda solution averaged 0.27, 0.37, 0.11, 0.42, 0.00, and 0.01, respectively. The pH values of the lemon, lime, orange, grapefruit, water, and baking soda solution were 3.5, 3.0, 5.0, 3.0, 6.5, and 9.0, respectively. From this data, I can conclude that grapefruits produce the greatest electric current and have the lowest pH value. The more acidic the substance is, the higher the electric current.

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Abstract: Science and Engineering Fair of Houston

1370

It Keeps Spinning: Revolutionizing Rolling Resistance

Lance Christmas
Houston ISD /BCM Academy at James D Ryan - MS

Category

Physics and Astronomy

This project is catered towards the testings of on how design affects How much rolling resistance is conducted at different angles using rotating objects (Beyblades).

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Abstract: Science and Engineering Fair of Houston

1371

How strong is air resistance

Youssef Mehanna
Weis Middle School

Category

Physics and Astronomy

Our goal was to see the effect of air resistance on gravity. So we measured how much a ball could last on the air on windy days and sunny days. So we found windy days increase air resistance by milliseconds that reached us to a conclusion that air resistance has effect on gravity.

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Abstract: Science and Engineering Fair of Houston

1372

Egg Drop

Calvin Goodall Goodall
Keller Vanderburg
Weis Middle School

Category

Physics and Astronomy

The purpose of the experiment is to see how we can improve parachutes. First we gathered all the materials that we needed for the experiment, then we built the parachutes, after we built the parachutes we dropped the eggs and recorded the data. The most important result is learning which parachute worked the best. Drop 2 survived and drop 1 had the worst damage.

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Abstract: Science and Engineering Fair of Houston

1373

"Asteroid Odyssey"

Eduardo Garza
Houston ISD /BCM Biotech Academy at Rusk - MS

Category

Physics and Astronomy

My project is about how the different types of materials and masses of an object affect the speed it takes to fall, the volume and density of the crater left out. The purpose of this project is to show an accurate model of asteroids/meteors and how impacting different ones can be. Since we don't have advanced technology to determine this, this project will give us data and describe how impacting each asteroid can be. With this data, we can comprehend better and prepare for an asteroid/meteor threat. I tested this using four different materials: Play-Doh, clay, styrofoam, and granite. I dropped these onto the flour and measured the object's speed, volume and density of the space left out. I found out that my hypothesis was partially correct. My data was very jumbled, so this showed me that there are a lot of other factors to consider such as the air resistance, their surface area, the material's density, the material composition, and more. What I would do to improve my data and future studies is to consider more variables in my experiments.

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Abstract: Science and Engineering Fair of Houston

1374

Hail Mary Physics

Kai Walker
Owen Megale
Weis Middle School

Category

Physics and Astronomy

To help football players accomplish touch down passes by learning what angle is the best to throw a Hail Mary. We believe that the Hail Mary Pass is a sacred right of passage in football history. By doing this projects, we believe we can develop a full-proof solution using angular projection.

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Abstract: Science and Engineering Fair of Houston

1375

Investigating Skyglow's Effects on Stargazing

Michelle Ou
Conroe ISD /McCullough Junior High

Category

Physics and Astronomy

As human civilization continues to rapidly urbanize, the widespread use of artificial light is causing light pollution, which brings negative effects on human health, disrupts the natural patterns of wildlife, and hinders our capability to see the stars. This project investigates the impact of skyglow, caused by artificial light sources, on the observations of the night sky. By using a digital camera and the image processing software, the relative intensity of skyglow was measured and quantified, and its relationship with star visibility was analyzed through the signal-to-noise ratio (SNR) - defined as the ratio of starlight (signal) to skyglow (noise). In urban locations, the skyglow intensity tends to be high. Conversely, rural areas tend to have lower skyglow intensity, allowing more stars to be visible. The results indicate that as skyglow intensity increases, the SNR drops, and the visibility of stars worsens. In addition to artificial light, the study also demonstrates that natural light, such as moonlight, affects star visibility. The difference in SNR between a full moon and a half moon is minimal while the difference between a half moon and a new moon is bigger. This project offers a simple yet effective way to measure and analyze the impact of skyglow on star observation, along with skyglow radiance in the red, green, and blue channels. It enables amateur astronomers to gain hands-on experience in light pollution research. By quantitative monitoring and tracking it over time, people can raise awareness of light pollution and obtain deeper insights into its effects.

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Abstract: Science and Engineering Fair of Houston

3349

Effect of Medium's Temperature on the Spring Constant

Heba Badat
Aldine ISD /Eisenhower HS

Category

Physics and Astronomy

When learning about spring constant in class, I was intrigued to explore factors that can affect a spring's constant. This experiment investigates the relationship between the temperature of a medium and the spring constant of a spring. The hypothesis states that as the temperature of canola oil increases, it heats the spring, which allows the spring to stretch more and subsequently lowers the spring constant. The independent variable is the temperature of the canola oil, while the dependent variable is the spring constant. Controlled variables include the volume of canola oil, the material and type of spring, and the mass used. Canola oil, chosen for its qualities of high temperature tolerance and translucency, was tested at nine temperatures between 5°C and 85°C. The experiment involved measuring the spring's displacement in the oil, accounting for refraction, and calculating the spring constant using Hooke's Law. Results confirmed the hypothesis: a change in the temperature of the medium affects the spring's behavior by altering the stiffness. As the temperature increases, the spring constant decreases. My investigation can be applied to the oil and gas industry. Oil extraction can be made efficient and be optimized with the understanding of how temperatures affect the movement of the spring.

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Abstract: Science and Engineering Fair of Houston

3350

Three-Dimensional Web Application to Simulate and Analyze the Effectiveness of Various Space Debris Removal Strategies

Silas Lovett
Friendswood ISD /Friendswood High School

Category

Physics and Astronomy

Space Debris is defined as the many inoperable man-made objects in orbit around the earth, such as dead satellites, flecks of paint, and coolant droplets. These debris fragments move at extremely high velocities, posing a large risk to satellites and spacecraft, and the problem keeps getting worse. In a theoretical worst-case scenario known as Kessler Syndrome, a chain reaction of orbital collisions occurs, resulting in low earth orbit becoming unusable for satellites, and drastically increasing the danger of space travel. Multiple hypothetical solutions for space debris exist, such as manual deorbiting, photon bombardment, and electrodynamic tethers. Limited research is available about these methods, and what is available is often incomplete. The goal of this project is to generate useful statistics about space debris removal methods using an accessible web-based simulation. This innovative simulation environment is highly configurable and includes a three-dimensional viewport for efficient, intuitive visualization. A website and a custom-built three-dimensional graphics engine were first created as foundational components to support this project. Next, an orbital simulation was developed to efficiently simulate the movement of objects in space. Building on this, multiple complex algorithms were designed to model autonomous space debris removal methods, including targeting and collection strategies. Finally, efficiency statistics are tracked over the duration of the simulation to gather information about these solutions and their respective algorithms. These statistics make useful predictions, and provide a platform for the rapid optimization and testing of current and future space debris mitigation methods.

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Abstract: Science and Engineering Fair of Houston

3351

Quantum Horizons: A Novel Approach to Overcome Time Dilation in Space Communication

Ram Magathala
Cypress Ranch - HS

Category

Physics and Astronomy

A phenomenon predicted by Einstein's theory of relativity, known as time dilation, creates synchronization challenges for systems moving at high velocities or when under varying gravitational fields. As velocity approaches the speed of light, normal synchronization methods experience significant errors or time delays (such as in communication between the stationary object and the one moving) which in turn hinders interplanetary communication and high speed data transfer. This project investigates the potential of a quantum coherence-based synchronization protocol (QCSP) to address these issues and offer enhanced accuracy and reduced error rates. To begin, this study uses Lorentz transformations and quantum mechanical principles, specifically the laws of quantum coherence and entanglement, in order to showcase the errors and time differences caused by both traditional and quantum based protocols. These values were visualized through graphs and tables, showing the relationship between relative velocity and synchronization error. Results indicate that QCSP reduces synchronization errors compared to traditional methods. This protocol (still in the developing process to apply to real life scenarios such as space travel) mitigates the effects of time dilation to a certain extent and provides almost instant communication and transfer of data. In conclusion, by addressing the challenges of time dilation and synchronization, this research could be a key breakthrough in enabling faster, more efficient interplanetary communication, paving the way for a new era of space exploration and making the dream of reaching distant planets with effective communication a tangible reality.

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Abstract: Science and Engineering Fair of Houston

3352

Using Computational Analysis to Determine the Relationship Between the Electroweak and QCD Phase Transitions and the Temperature Perturbations in the Cosmic Microwave Background

Auyush Ganapathy
Clear Creek ISD, Clear Springs High School

Category

Physics and Astronomy

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Abstract: Science and Engineering Fair of Houston

3353

IsoFlow: Optimizing Medical Radioisotope Production Pathways for Nuclear Medicine Applications

Neel Chandalia
Houston ISD /DEBAKEY HIGH SCHOOL FOR HEALTH PROFESSIONS - HS

Category

Physics and Astronomy

Medical radioisotopes are critical for diagnostic imaging and therapeutic applications in nuclear medicine, yet optimizing their production pathways remains a significant challenge. This project, IsoFlow: Optimizing Medical Radioisotope Production Pathways for Nuclear Medicine Applications, introduces a novel approach to enhance the efficiency and precision of specific nuclear pathways recognized for producing essential medical isotopes such as alpha-particle-induced reactions that emit two neutrons (α,2n). By leveraging extensive experimental data from the EXFOR database, this study consolidates and reconstructs data from over 30 isotope reactions to inform predictive modeling. Various machine learning approaches were tested, with Recurrent Neural Networks and Gradient Boosting demonstrating superior performance in handling complex reaction datasets. The project developed two core models per pathway: one to optimize cross-section (probability of reaction occurrence) values based on variables such as beam energy and atomic mass, achieving an R-squared (coefficient of determination) value > 0.9 (90%) accuracy; and another to predict and optimize reaction rates using beam energy, cross section, and areal density. These models allow for precise identification of optimal conditions for medical isotope production, enabling scalable, cost-effective, and efficient pathways. The implications extend beyond improved isotope yields to influencing cyclotron and particle accelerator design, thus advancing decentralized production capabilities for nuclear medicine facilities. This work paves the way for precision-driven innovations in medical radioisotope production, meeting the growing demands of nuclear medicine while optimizing resource usage.

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Abstract: Science and Engineering Fair of Houston

3354

Guardians of Safety: Efficacy of Guardian Caps on the Reduction of Force Impact in Drop Tests

Jacob Robin
Rylen Box
Conroe ISD /ASHP: Academy for Science and Health Prof

Category

Physics and Astronomy

Long-term complications, including behavioral, cognitive, and physical burdens, from repeated head force traumas experienced by American football players have been a growing concern among the medical and scientific communities in recent years. Guardian Caps, soft shell coverings for standard football helmets intended to minimize force impact, are a potential solution to reduce the severity of head force trauma. This experiment examines the efficacy of Guardian Caps in reducing head force trauma sustained by American football players. Using a force probe and drop tests onto a force plate, we compared head force impact in a football helmet covered with a Guardian Cap (test group) to a helmet without the soft shell padding (control group). Helmets were dropped from a height of one meter, and ten trials were conducted for the test group and control group. Force was measured in Newtons, and the mean, standard deviation, and standard error were determined for the test group and control group. T-values were calculated and compared to the critical value for a one-tailed T-test. The results indicate that there is not a statistically significant difference in force exerted within the helmet between the control group and test group, and Guardian Caps do not reduce head force trauma.

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Abstract: Science and Engineering Fair of Houston

3355

The "Sole" Reason We Can Walk: Friction Coefficients and Different Types of Shoes

Makayla Ross
Tahir Salau
Harmony South District

Category

Physics and Astronomy

This project investigates the physics of friction by analyzing the performance of various shoe soles on different surfaces, focusing on the coefficients of static and kinetic friction. Friction, a force opposing motion, is vital in maintaining grip and preventing slips, making it a key factor in footwear design and safety. The study examines how different shoe sole materials, patterns, and designs interact with concrete, tile, wood, and carpet surfaces. Through controlled experiments, the static friction (required to initiate motion) and kinetic friction (resistance during motion) are measured using a force sensor and inclined plane setup. The experiments highlight the relationship between the normal force, surface texture, and the nature of the contact area. Athletic shoes, designed with high-friction rubber soles and textured treads, exhibit higher friction coefficients, making them suitable for dynamic movements on most surfaces. Conversely, formal shoes with smooth leather soles show lower friction, increasing the likelihood of slipping, particularly on smooth or rough surfaces. Environmental factors, including surface moisture and debris, further influence friction, altering the contact between shoe soles and the ground. These findings have practical implications for footwear design, enabling manufacturers to optimize soles for specific applications, such as maximizing grip for athletic shoes or ensuring adequate slip resistance for formal footwear. The research also benefits consumers, guiding them in selecting footwear that aligns with their needs and environments, ultimately enhancing safety, performance, and comfort across various activities.

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Abstract: Science and Engineering Fair of Houston

3356

TunnelVision

Sathyan Gopal
Arnav Nemade
Divin Giddaluru
Houston ISD /Carnegie Vanguard HS

Category

Physics and Astronomy

Quantum tunneling is a fundamental phenomenon in quantum mechanics, which allows particles to pass through energy barriers that they could not classically. The concept is crucial in many scientific and technological developments such as tunneling diodes, quantum computing, and the construction of scanning tunneling microscopes. Despite its importance, quantum tunneling is hard to imagine and understand for many students, especially at the high school and undergraduate levels. This project aims to bridge that gap by building an affordable quantum tunneling simulator based on Arduino. By presenting the very abstract phenomenon of quantum tunneling in an interactive, visual way, the project develops scientific knowledge and awakens curiosity in the sphere of quantum mechanics. It further reveals the role that quantum tunneling plays in everyday society by enabling much of today's electronics and nanotechnology innovation. This educational tool may inspire future research and interest in quantum science among students and science enthusiasts.

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Abstract: Science and Engineering Fair of Houston

3357

Quantum Cats

Rosette Calvillo
J. Frank Dobie High School

Category

Physics and Astronomy

Galactic cosmic rays (GCRs) are remnant particles of ranging origin, from supernova to our very own Sun, that enter our atmosphere and emit ionizing radiation as a byproduct of high energy travel. However, not much research has been conducted surrounding the impact and correlation between intensity of these particles and a weakening of our atmosphere in polluted areas. More specifically, there has been little exploration into whether an increase in frequency of GCRs results from air pollutants and greenhouse gases negatively affecting our atmosphere in specific areas. This experiment aims to investigate whether a possible correlation exists between an increase in frequency of GCRs and a weakened atmosphere due to air pollutants. Such information could contextualize certain health issues within higher pollution areas that can be traced to ionizing radiation exposure.

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Abstract: Science and Engineering Fair of Houston

3358

Cost-Effective Wireless Charging

Lukas Frankenfield
Umar Akhtar
Conroe ISD /ASHP: Academy for Science and Health Prof

Category

Physics and Astronomy

The goal of this project was to construct a wireless charging system that utilized cheaper components while still providing the ability to transfer energy efficiency. The transmitter (charger) and receiver (phone/load) circuits from commercial products were replicated, using a signal generator, inductor, capacitor, transistor in the transmitter circuit. The cheaper materials used were an aluminum inductor, electrolytic capacitor, a smaller transistor, and a smaller gauge of wire for the inductor. A multimeter was used to measure the power received by the receiver and the power transmitted by the transmitter to get efficiency. The original circuit gave 76% efficiency, the aluminum inductor gave 67% efficiency, the electrolytic capacitor did not provide wireless energy transfer, using a smaller transistor led to 74% efficiency, and using a thinner wire led to 73% efficiency. The transistor and thinner wire led to insignificant changes in efficiency compared to the original circuit, the electrolytic capacitor was not viable in a wireless charger, and the aluminum inductor was only 9% less efficient than the ideal circuit. In conclusion, the transistor and wire gauge could be looked into and could lower the price, and an aluminum inductor can possibly be used in the future if efficiency is increased, as ideal wireless charging already has lower efficiency. One thing this project conveys is the trade-off between performance and price/sustainability. This project is important for the future because it is crucial to lower input resources and costs as certain materials like copper or semiconductors become less abundant.

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Abstract: Science and Engineering Fair of Houston

3359

Soundscapes: Exploring How Materials Shape Sound Quality

Mark Nwaokolo
Mark Datuin
Xander Richardson
Fort Bend ISD /Hightower High School

Category

Physics and Astronomy

This study, "Soundscapes: Exploring How Materials Shape Sound Quality," looks into how various materials (foam, glass, metal, wood, and wool) influence sound recording quality. The experiment measured sound levels, echo duration, and clarity by recording a consistent sound in surroundings including each material. The results revealed that foam and wool successfully absorbed sound, reducing echo and boosting clarity, whereas glass and metal reflected sound, causing substantial echoes and reducing clarity. Wood performed well in terms of both sound absorption and reflection. These findings shed light on optimizing materials for sound recording environments, making this project useful for audio engineering and acoustics design.

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Abstract: Science and Engineering Fair of Houston

3360

The Aerodynamics of the Dimples on a Golf Ball

Kalen Ward
Conroe ISD /AST: Academy of Science and Technology

Category

Physics and Astronomy

The objective of this experiment was to determine which golf ball featured a dimple pattern with the lowest drag coefficient. To achieve this, a wind tunnel was created using a fan with adjustable speeds to test four distinct types of golf balls at three different speeds. The drag was assessed by comparing the airspeed of each golf ball to the airspeed recorded without any golf ball present. The golf ball that exhibited the slowest airspeed demonstrated the highest level of drag. It was noted that at lower speeds, the differences among the golf balls were minimal; however, at higher speeds, the deviations became more pronounced. Among the four types of golf balls tested, the fourth variety demonstrated the highest coefficient of drag, whereas the first variety exhibited the lowest coefficient of drag. This indicates a significant variance in aerodynamic performance among the tested samples.

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Abstract: Science and Engineering Fair of Houston

3361

The Effects of Incline Slopes on Horizontal Velocities of Objects

Lucas Rigoulot
Clear Creek ISD /Clear Lake High School

Category

Physics and Astronomy

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Abstract: Science and Engineering Fair of Houston

3362

The Physics And Aerodynamics Of Formula One

Bernhis Tembo Loubaki
SST - Champions College Prep - HS

Category

Physics and Astronomy

For years formula one has been the pinnacle of motorsport and automotive engineering. We want to analyze how modern formula one cars manipulate the air around them to dominate on the racetrack. we want to build our own small scale desktop wind tunnel and explain how these racecars are so fast.

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Abstract: Science and Engineering Fair of Houston

3363

Basketball In Action!

Samuel Herrera
Aldine ISD /Eisenhower HS

Category

Physics and Astronomy

The title of my project is "Basketball In Action!" . My project was based on how a basketball bounced, my research was to find out how much energy did the basketball lose after the first bounce and also what surface absorbed the balls energy the most on the first bounce. I did 3 different trials for the 4 different surfaces I used so I was able to get accurate information and be able to get something out of it. I recorded videos of me doing the actual project so I could go back and pause it whenever I want to check where the first bounce went up to and measured from there. I dropped it from an specific height which was 4 feet for each trial and used painters tape to accurately measure how high did the ball bounce on the first bounce. The observations I made were that my prediction wasn't as I expected when testing all the different surfaces. To accurately get the information I also put the exact PSI as it says in the ball. The result was that grass absorbed more energy from the ball than the carpet as I had predicted.

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Abstract: Science and Engineering Fair of Houston

3364

Floating on Sound: Exploring the Power of Acoustic Levitation

Carson Doleman
Anthony Chavez Samano
Conroe ISD /ASHP: Academy for Science and Health Prof

Category

Physics and Astronomy

This experiment investigates how different weights and materials affect the ability of sound frequencies to manipulate objects in the air. Acoustic levitation is the study of manipulating objects into the air without physical contact using sound waves which contains applications in medical, science, and space exploration studies. The research question for this experiment; "Can a frequency of 40kHz support different materials of different weights better than others?". An ultrasonic transducer kit will be used to generate the sound waves, and in addition monitor sound levels with a decibel meter in order to ensure safety. With our experiment completed, we found that there is no statistical if different materials can affect if an object will levitate in the acoustic levitator. We took note that maybe different shapes could have affected if an object would float, so the shapes of the materials were altered to roughly be similar but the results stayed the same. The aim of the project was to gain a deeper understanding of acoustic levitation and how different materials and masses can affect the ability of the object being manipulated in the air via sound waves.

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Abstract: Science and Engineering Fair of Houston

3365

How does force affect an object's motion?

Chrishell Payne
SST - Champions College Prep - HS

Category

Physics and Astronomy

I'm going to use an interactive rocket balloon car to represent how force affects an object's motion. I will also study what causes objects to move faster, slower, or not at all. I will be using Newton's laws throughout my experiment. My hypothesis of this project is that the more air there is in the balloon the faster and farther the car will go. In my project I will explain how Newton's third law is used, how one force results in the reaction of another force (forces come in pairs), how different masses cause different accelerations, and how any type of motion requires some kind of force.

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Abstract: Science and Engineering Fair of Houston

3366

Mitigating the Curse of Dimensionality: A Parallel Sub-Circuit Quantum k-Nearest Neighbors Approach for High-Dimensional Data Classification

Azhmeer Jesani
Clear Creek ISD /Clear Creek High School

Category

Physics and Astronomy

Real-world datasets have an increasing number of features for classification, causing k-Nearest Neighbors (k-NNs), one of the world's most widely used classification algorithms, to fail to reach a large degree of accuracy in high-dimensional data and therefore fall victim to the "Curse of Dimensionality." By depending on calculating distance, k-NNs unleash their advantages in low-dimensional data and disadvantages in high-dimensional datasets. However, Quantum k-Nearest Neighbors (Qk-NNs), which rely on quantum mechanics to process information and compute distance metrics differently, may potentially replace Classical k-Nearest Neighbors (Ck-NNs) for high-dimensional data structures. Therefore, the project aims to compare Ck-NNs versus Qk-NNs in high-dimensional data. A dataset with 10,000 features (ARCENE) was chosen to classify inputs as 1 or -1. The dataset was normalized, split into subcircuits, computed, and then classified. Seven trials of accuracy with k-values ranging from 1 to 50 were conducted for both Ck-NNs and Qk-NNs to locate any potential benefits of utilizing Qk-NNs. While Ck-NNs had higher accuracy rates with lower standard deviations, Qk-NNs showed potential as their accuracy increased with higher k-values. When analyzing the data, the difference between the average accuracy (Ck-NNs minus Qk-NNs) decreased as k increased, suggesting that if this trend continued, Qk-NNs could have similar or better accuracy than Ck-NNs. Thus, Qk-NNs can be a viable alternative for Ck-NNs when computing with high-dimensional data, provided there is a high k-value. Lastly, this is an applicable alternative in AI and medical research that requires the classification of high-dimensional data and uses more complex classification algorithms.

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Abstract: Science and Engineering Fair of Houston

3367

Throwing Shade

James Godkins
madelyn sharp
Jacob Hollis
Conroe ISD /ASHP: Academy for Science and Health Prof

Category

Physics and Astronomy

This study examines the statistical differences in the angles of baseball pitches, specifically focusing on the curveball and fastball. Pitches in baseball are characterized by trajectory, speed, and spin, all of which influence the angle at which they approach the batter. By analyzing pitch data from Major League Baseball using YouTube pitching videos, and using an app to determine the angles in the arm angle measurements, the angle of the arm was measured starting from the forearm to the bicep, and to the elbow, shoulder, and mid-side, including release angles of curveballs and fastballs. The results show that curveballs generally exhibit a more significant vertical drop and sharper break compared to fastballs. A paired T-Test was used. Statistical analysis reveals a difference in the release angles, with curveballs having a greater deviation in both arm angles. These differences in pitch angles contribute to the different movement patterns and the difficulty of hitting these two types of pitches. The findings suggest that the physics of pitch mechanics play critical roles in influencing the overall angle and movement of the pitches.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human participants ☐ potentially hazardous biological agents

☐ vertebrate animals ☐ microorganisms ☐ rDNA ☐ tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

☒ yes ☐ no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

☐ yes ☒ no

4. This project is a continuation of previous research.

☐ yes ☒ no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

☐ yes ☒ no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

☒ yes ☐ no

Abstract: Science and Engineering Fair of Houston

3368

Investigating the Effect of Qubit Type on Quantum Computing Viability

Jesse Miller
Conroe ISD /AST: Academy of Science and Technology

Category

Physics and Astronomy

This experiment investigated the characteristics of the decoherence of qubits in photonic quantum computers and the effects of decoherence on the superimposed state of the qubit. Three different tests were run to characterize decoherence, comparing photonic qubits to superconducting qubits. The first test investigated the decay rate of qubits of both types based on T1 decoherence. Additionally this test investigated the differing effects of increasing qubits numbers for both types of qubits. This test saw that photonic quantum computers decreased decoherence more then superconducting per each qubit added. The second test, a T2 Hahn test, showed the effect of qubit number on the overall decoherence of a quantum computer. This test was run for both types of qubits with a range of qubit numbers from two to eight. The photonic quantum computers saw not only lower decoherence but also, as the number of qubits increased, a greater gain in stability per qubit added. The number of qubits were shown to decrease the decay rate of the quantum computers with greater effect in the photonic system. The third test performed was a T2 Ramsey test which investigates the qubit oscillations after failing to land in a perfect excited state. Photonic qubits decayed along the z axis at a lower rate than superimposed qubits during this test. Overall it was observed that photonic quantum computers are able to decrease decoherence compared to superconducting quantum computers. Additionally they are able to gain more stability per qubit added from increasing qubit numbers per computer.

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Abstract: Science and Engineering Fair of Houston

3369

Numerical Transition Radiation Simulations For Electron Beam Structure Analysis And Machine Learning Modeling

Andy Long
Seven Lakes - HS

Category

Physics and Astronomy

Laser Wakefield Accelerators (LWFA) are at the frontier of new particle discovery, achieving energy levels comparable to the LHC in compact tabletop setups due to their ultrahigh acceleration gradients. However, optimizing these accelerators is computationally intensive, even for GPU supercomputers, as it requires modeling complex relativistic and radiation mechanics for thousands of electron fields. This study develops CPU-based numerical simulations to elucidate the relationship between electron beam structures and emitted transition radiation, enabling determination of the 3D electron number density and generating data to train a neural network. Utilizing Python with SciPy and Dask, simulations modeled electromagnetic field changes and calculated Poynting vectors (light intensity) for varying parameters including wavelength, Lorentz factor, acceptance angle, number of electrons, and spatial distribution standard deviations to create comprehensive datasets. Visualization with Plotly and Mayavi confirmed the simulations accurately predicted transition radiation from electron beam structures. Results showed a strong positive (approx. r = 0.7) linear correlation between radiation intensity and beam structure consistent with GPU-based calculations. The successful generation of many comprehensive datasets through numerical simulations highlights the potential of neural networks to significantly accelerate this process and reduce dependency on GPU supercomputers. This advancement paves the way for developing next-generation "tabletop" accelerators that are smaller yet as powerful as large RF accelerators (LHC), potentially even enhancing medical imaging technologies like MRI scans and accelerating the discovery of new subatomic particles!

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Abstract: Science and Engineering Fair of Houston

3370

Splatter Matters: Unraveling the Secrets of Bloodstain Patterns

Samanta Bonilla
Alief ISD

Category

Physics and Astronomy

I wanted research a problem in the world of forensic science to understand how cases get solved. One of the many ways investigators solve crimes is through evidence. Blood spatters is one of the forms of evidence that police can use. When going through the air the blood droplets are round but as they drop to the surface they form different patterns. With the different shapes detectives can tell how the person lost the blood and what weapons were used. In criminal investigations there are 3 types of blood spatters: low velocity, medium velocity, high velocity and sometimes crazy person spatter. Low velocity spatter usually occur from low-impact blows or after the victim is injured. Medium-velocity spatter occur with blunt objects or when blood spurts out of the wound. High velocity spatter most likely occurs with gunshot wounds. Crazy spatter is rare but does occur. I decided to conduct an experiment focused on how the height from which blood is dropped affects the diameter of resulting blood spatters, essential for reconstructing criminal activities. Utilizing a controlled setup with synthetic blood droplets were released from different heights (6 in, 12 in, 18 in, 24 in, 30 in, 36 in). Each drop landed on a piece of acrylic paper where its measurements were recorded. Observations indicated that as the height increased, the spatters became more erratic and larger, necessitating the use of progressively larger paper to accurately capture the patterns. Notably, the droplets expanded in diameter and developed secondary features such as satellite droplets and tails, particularly at higher elevations. My experiment confirmed the hypothesis that greater heights lead to larger spatter diameters, providing crucial insights into the dynamics of blood droplet dispersion at crime scenes. This information offers valuable insights for forensic investigators to deduce the circumstances surrounding a crime, including the potential position and actions of a victim. Future experiments could expand on these results by exploring the effects of different drop angles to further enhance forensic analysis capabilities.

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