Student Talks and Posters

Talks

(Group 1)

Rachel Brunetti, ***Cell Viscoelasticity as a Function of Substrate Stiffness Quantified by Atomic Force Microscopy***

Little is known about mechanosensing and the means by which such stimuli are transduced. Information on cell viscoelasticity as a function of substrate stiffness and vimentin levels can lead to a larger composite model of cell mechanotrandsduction.

Monique Windju, ***Modeling the Evolution of Double White Dwarf Binary Star Systems***

Understanding the physics of compact binary star systems is a rapidly developing field that extends our knowledge of star formation, stellar evolution and explosive phenomena. I will present a brief introduction of the evolution of double white dwarf binaries together with a detailed assesment of the type of explosive phenomena that occurs when these systems merge.

Emily Yang, ***High-Resolution Spatial Mapping of Thin-Film Photovoltaic Cells***

We implemented a lumped circuit model to extract often-overlooked solar cell parameters. In a new approach to the LBIC technique, we then used the broad wavelength range of a supercontinuum laser to try to extract these parameters on a spatial scale.

(Group 2)

Mary Lou Bailey, ***Developing High Quality Absorbers for Terahertz Spectroscopy***

Many techniques use terahertz radiation to study properties of matter. One prominent example is Electron Paramagnetic Resonance (EPR) spectroscopy. EPR investigates unpaired electron spins in solids and liquids to reveal their local environment; in biology, it reveals critical structural information of proteins. At UCSB we have developed a high-field EPR spectrometer that excites and detects spins 100x faster than otherwise possible by using a Free Electron Laser (FEL) source, which provides high power at the frequencies necessary for high-field EPR. In EPR experiments, the FEL pulse is directed at a sample, where rapidly decaying signals emitted by the electron spins are measured by a detector. Since the FEL pulse travels through open space, some of this light pulse is scattered and reaches our detector, obscuring the signal from our sample. In order to realize the full potential of the spectrometer, it is crucial to minimize scattered light. Absorbers in the terahertz range exist, but are extremely costly and bulky. Hence, we have successfully designed and fabricated a compact, cost-effective absorber using a thin film technique. The absorber consists of a thin layer of plexiglass placed over a small volume of water, rendering destructive light interference and thus minimal reflections. Light not reflected back is absorbed by the water. Testing this new absorber with our Vector Network Analyzer shows absorption is optimal at 240 GHz, the frequency used for FEL EPR experiments. Further studies show that using a solution of water and glycerol increases the absorption to a range above that of absorbers currently available on the market, improving our initial design.

Lauren Gilbert, ***Active-Sterile Neutrino Mixing In Big Bang Nucleosynthesis***

We examine the effect of active-sterile neutrino mixing on standard Big Bang nucleosynthesis (BBN). Sterile (right-handed) neutrinos would decouple at a much higher temperature than left-handed neutrinos. However, given a non-zero active-sterile mixing angle, the thermally-

decoupled sterile neutrinos would affect thermally-coupled active neutrinos. Since the neutron-to-proton ratio depends sensitively on the population of electron neutrinos, and BBN on the neutron-to-proton ratio, active-sterile mixing could affect primordial abundances of light elements We simulate a simple system in which only electron neutrinos and sterile neutrinos oscillate between flavors. We then run ``standard'' BBN (Wagoner, Fowler and Hoyle 1967) with a variety of mixing angles and mass differences. By matching observations of primordial elemental abundances and the results of BBN with active-sterile oscillations, we can limit the parameter space for rest mass and mixing angle of sterile neutrinos.

Mackenzie Leake, ***An Application of K-means Clustering to Professor Recommendation***

Machine learning algorithms have become an important analytical tool across many disciplines. K-means clustering, an unsupervised learning algorithm, is a tool used to find structure within many different types of data, ranging from neurological features to image data. We have implemented the k-means algorithm to design a recommendation system to suggest professors to students based on both user input and peer review data. We used k-means clustering to group Pomona College professors based on numeric ratings and descriptions of professors from an online source of student reviews. We validate our data using statistical, quantitative methods and more qualitative analysis to verify the quality of the suggestions we provide to users.

(Group 3)

Deanna Gelosi, ***Assessing Student Prior Knowledge with the Candle Problem***

Presenting the candle problem in high school physics before teaching thermodynamics can be an assessment tool for student prior knowledge, illuminating qualitative understanding of independent variables and misconception in foundational knowledge.

Kaitlyn Parsons, ***Transient Heat Conduction in Cylindrical Coordinates***

2D heat conduction in a cylinder is represented by the heat equation in cylindrical coordinates. This was solved analytically using Bessel Functions due to the time dependent forcing on the boundaries. In addition to solving analytically, an experiment was conducted to verify theory with actual data. The experiment used a conduction cylindrical apparatus with a radius of 150 mm and height of 35 mm. An electric heater located in the center of the cylinder heated the apparatus while cool water from a water chiller flowed simultaneously around the outside. The heat equation was used to analyze the data from the experiment.

Tanmayi Sai, ***The Black Clouds***

The search for a hypothetical ninth planet in our solar system, Tyche, resulted in the findings of a blackbody in the mid –infrared rang. This extreme carbon star is one of the few such candidates that tell us about carbon formation.

Posters

Rose Baunach, ***Thermal Conductivity Measurements of AlZrOx via the 3ω Method***

Rachel Brunetti, ***Cell Viscoelasticity as a Function of Substrate Stiffness Quantified by Atomic Force Microscopy***

Andrea Derdzinski, ***The Pre-Explosive Evolution of the Double Degenerate Binaries: Implications for the External Medium***

Adrienne Ertel, ***A Typical Elliptical Galaxy: Mass Profiles and Supernovae Enrichment***

Xue Fan, ***Lithium Iridate Growth***

Deanna Gelosi, ***Assessing Student Prior Knowledge with the Candle Problem***

Lauren Gilbert, ***Active-Sterile Neutrino Mixing In the Big Bang Nucleosynthesis***

Amandeep Gill, ***Undergraduate Skills Laboratories at Sonoma State University***

Brianna Grado-White, ***PMT Properties in MiniCLEAN Simulations***

Hannah Klion, ***Gravitational Waves from Rapidly Rotating Core-Collapse Supernovae***

Mackenzie Leake, ***Building a Professor Recommendation System Through K-means Clustering***

Megan Long, ***Simulation of electron-ion recombination in high-pressure xenon gas with molecular additives in pursuit of directional dark matter detection***

Jessica Luna, ***Ysovar: The Age of the Cepheus C Star Cluster***

Kaitlyn Parsons, ***Fourier-Bessel Decomposition of Transient Heat Conduction in Cylindrical Coordinates***

Samira Rezaei, ***Designing Low-Cost Prosthetic Arm***

Kristine Rezai, ***A magnetic Wire Trap for High Field Seeking Ultracold Neutrons***

Tanmayi Sai, ***The Black Clouds***

Maissa Salama, ***Gemini Planet Imager: Detecting Exoplanets by Direct Imaging***

Emily Yang, ***High-Resolution Spatial Mapping of Thin-Film Photovoltaic Cells***