Senior Thesis Presentations

Part 1: Tuesday, May 31, 2016
Weniger 304, 3:00-5:00pm

3:00 – 3:10 Conner Bice
Simulating Synchrotron Optical Flashes in the Reverse Shock of a Gamma Ray Burst
Advised by Davide Lazatti

3:12 – 3:22 Job Guidos
3D Soft-Body Collisions in a Gravitational Field
Advised by Davide Lazatti

3:24 – 3:34 Katherine Banowetz
Quantifying the Effects of Acoustic Coupling on Advanced LIGO
Advised by Dr. Schofield (UO REU)

3:36 – 3:46 Griffin Alberti
Exploring Frequency Responses of Custom Spider Web Geometries using Physical and Computational Models
Advised by Ross Hatten (ME)

3:48 – 3:58 Nicholas Groves
Look Ma, No Beads: Analyzing Traction Force Characteristics of Migratory Adenocarcinoma in H*eterogeneous Type 1 Collagen through Bead-free Confocal Microscopy*
Advised by Bo Sun

4:00 – 4:10 James Compeau
High-field Terahertz Spectroscopy of Optically Excited Gallium Arsenside
Advised by Yun-Shik Lee

4:12 – 4:22 Jeremy Rath:
Organic Semiconductors: Incorporating Xylindein into (opto)Electronic Devices
Advised by Oksana Ostroverkhova

4:24 – 4:34 Gregg Stevens:
Characterizing a Coupled Photodiode-LED System for Neuro-Sensing Applications
Advised by Ethan Minot

Senior Thesis Presentations

Part 2: Tuesday, June 7, 2016, Weniger 304, 3:00-5:00pm

3:00 – 3:10 Brenden Vischer: *Free Energy Decomposition of the Critical Square-Well Liquid Using a Renormalization Group Method*
Advised by David Roundy

3:12 – 3:22 Samuel Grimm: *Crystal Morphology and Dimensionality Determine the Electronic Response in Novel Semiconducting Materials*
Advised by Matt Graham

3:24 – 3:34 Alex Peterson: *The Thermal Conductivity and Diffusivity of Thin Films Using Time Domain Thermoreflectance Experiments*
Advised by Matt Graham

3:36 – 3:46 Bret Brandner: *Implementation of a Comparative Method for Measuring Fluorescence Quantum Yield of Novel Compounds in Solution*
Advised by Matt Graham

3:48 – 3:58 Joshua Stahly: *Electrical Transport Measurements on the Alloy* $Sn_{1-x}Ca_xSe$
Advised by Janet Tate

4:00 – 4:10 Daniel Speer: *Room Temperature Seebeck Measurements of Silicon Wafers and Thin-film Tetrahedrite Derivatives* $Cu_{10-x}Ag_xZn_2Sb_3S_{13}$ *on Silicon Substrates*
Advised by Janet Tate

4:12 – 4:22 Evan Peters: *Data Driven Study of Neutron Response in MINERvA using Quasielastic Neutrino Scattering*
Advised by Heidi Schellman

4:24 – 4:34 Mitchel Elliot: *Solving for the Ground State Energy of a Noninteracting Electron Gas Using the Density Operator*
Advised by Henri Jansen

4:36 – 4:46 Jayde Templin: *Experimental Apparatus for Measuring Heat Memory of Drosophila Melanogaster Utilizing Thermal Electric Devices*
Advised by Tom Giebultowicz

Abstracts and Biographies:

Conner Bice

Simulating Synchrotron Optical Flashes in the Reverse Shock of a Gamma Ray Burst

We construct a Monte Carlo Simulation in Python to demonstrate the optical flashes at 5×10^{14} Hz peaking at 6×10^{31} erg $s^{-1} Hz^{-1} St^{-1}$ due to synchrotron radiation from the reverse shock of a gamma-ray burst's jet. While analytical solutions to this problem exist, they rely on sweeping simplifications of what is necessarily a highly variable and complex system. The simulation expands upon the well understood properties of single-electron synchrotron to predict observer-frame light curves from isotropic but analytically intractable outflows. The light curves produced compare favorably with theoretical predictions for simpler jets. Unfortunately, the simulation so far fails to resolve features associated with the geometry of our jet. Work continues toward a solution to this problem.

Connor Bice is originally from Aloha, Oregon and is graduating with a Physics/Math double major at Oregon State University. In his time there, he has won several Physics scholarships as well as the Joel Davis award for Mathematics. After graduating, Connor will continue his studies as a PhD student in CU-Boulder's Department of Astrophysics and Planetary Sciences. With his precious free time, he enjoys making his roommates throw their controllers and occasionally seeing the sun.

Job Guidos

3D Soft-Body Collisions in a Gravitational Field

A self-gravitating soft-sphere collision system is created for simulating phenomena such as asteroid collisions, dust conglomeration, and planet formation, however, its functionality could also be applied in simulations of fluids in general. We analyze effects of particle properties including spring constant, coefficient of restitution, coefficient of friction, mass, density, and radius for simulations. These simulations include a projectile fired at a cluster, two clusters interacting, and deformation of a rotating cluster. A series of simulations are performed for incremental increases in projectile kinetic energy incident on a stable particle cluster of known potential energy. Remaining bound mass is compared with projectile kinetic energy to plot their relationship. In the next simulation, two clusters collide resulting in conglomeration of the majority of particles with some stable orbiting bodies. Finally a cluster is formed with a non-zero total angular velocity and the radius of each particle is reduced to simulate compression of mass. Conservation of angular momentum causes the cluster to increase angular velocity and accrete from the cluster into a disk. We also explore instabilities in simulation which result in drift of ideally conserved quantities including energy, linear momentum and angular momentum. It is our hope that the progress made in this project toward efficiency and energy conservation will help to create better models of a wide variety of astrophysical phenomena and otherwise.

Job Guidos is a senior in physics at Oregon State University. He began his college education in mathematics at Southern Oregon University before transferring to OSU. He is now performing computational research in astrophysics under Dr. Davide Lazzati. He has a passionate interest in space exploration and understanding the universe, and hopes to contribute to the technological progress of both and perhaps to inspire interest in others via computational visualization in documentary and film. Before attending university he was enlisted in the U.S. Army as a Military Intelligence Systems Integrator. In addition to his work, he enjoys rock climbing, coed partner stunting, and various other challenging outdoor activities.

Katherine Banowetz

Quantifying the Effects of Acoustic Coupling on Advanced LIGO

The Laser Gravitational Wave Observatory, or LIGO, is built to observe gravitational waves as they propagate through space. Advanced LIGO is extremely sensitive to movements of the test mass as small as$10^{-21} \frac{m}{\sqrt{Hz}}$, which allows many signals other than gravitational waves to be detected by the system. Pressure created by external sound can alter the measurement by creating Doppler shifts, intensity fluctuations, and scattering in the laser beam. To determine the areas affected by sound external to the vacuum system, we inject acoustic noise in the laser and vacuum equipment area. On a smaller scale, vibrating a horizontal access module or beam splitting chamber with a shaker tests the impact of sound on single chambers. To calculate the scale at which these vibrations impact the signal as well as the effect of other environmental injections, a program that analyzes ambient background noise signals as well as injections with coupling functions to determine the estimated background level of the environmental signal was created. This data analysis program was used to determine the estimated background level of acoustic coupling for each horizontal access module and a ranking of the vacuum chambers most affected by acoustic coupling was developed from this. It was determined that two vacuum chambers had background levels above $10^{-20}\frac{m}{\sqrt{Hz}}$. Tests on materials to limit acoustic coupling within a horizontal access module were also conducted and found that using dampening clips within the vacuum chamber was a possible solution to limit acoustic coupling in the 750 Hz range for that chamber.

Katherine Banowetz grew up in Corvallis, OR and graduated from Crescent Valley High School in 2012. She attended Macalester College for a year and then transferred to Oregon State University, where she majored in physics. At Oregon State, Katherine has been an active member of Delta Delta Delta and worked as a TA for the undergraduate electronics series. Katherine completed a summer REU at LIGO Hanford through the California Institute of Technology's LIGO SURF program in the summer of 2015, where she completed her undergraduate thesis research. After graduating from Oregon State University, Katherine will be attending the University of Wisconsin-Madison to pursue her PhD in medical physics. She eventually hopes to work as a medical physicist in a clinical setting with a focus on radiation therapy.

Griffin Alberti

Exploring Frequency Responses of Custom Spider Web Geometries using Physical and Computational Models

Web-building spiders typically rely on vibrations in their webs to detect what is in them, but the lack of control over the geometry and tension of real spider webs makes it difficult to determine how those parameters affect this phenomenon. We explore the frequency response function of several custom orb-web geometries using both a physical model and computational model. The physical model consists of a 1.2m diameter web made of thin rope, with eight accelerometers arranged around the center to measure vibrations where a spider's feet would be. A mock spider can also be placed in the center to simulate the effects real spiders might have on their own webs' vibrations. Our computational model predicts the frequency response of the physical model using a technique called dynamic substructuring. The computational model works under the approximation that the web's amplitude of vibration scales linearly with excitation amplitude. We found that both models give frequency response functions with similar features at excitation frequencies between roughly 10Hz and 30Hz. Adding the artificial spider to the web introduced a new mode in which its body oscillated 180° out of phase with the rest of the web. At many frequencies, the leg closest to the excitation vibrated less than other legs, indicating that a spider on our web may not be able to simply move in the direction of the leg that vibrates most to locate prey effectively.

Griffin Alberti grew up in Los Angeles, CA and graduated from Corvallis High School in 2011. Undecided in major but hoping to study robotics, he enrolled at Linn Benton Community College and took part in their underwater remotely operated vehicle team for three years. Eventually, he decided that the universe was too interesting to stop taking physics classes and transferred to OSU as a physics major, later picking up a math minor. His interest in robotics never subsided, and he plans to return to OSU for an MS in robotics next year in the hopes of learning more about control theory and kinematics. His other interests include hiking, piano, computer animation, and thinking about how strange everything is.

Nicholas Groves

Look Ma, No Beads: Analyzing Traction Force Characteristics of Migratory Adenocarcinoma in H*eterogeneous Type 1 Collagen through Bead-free Confocal Microscopy*

Current methods in traction force analysis rely on a homogeneous extra-cellular matrix and embedded microbeads to track deformations. The efficacy of these methods decreases when the matrix is not homogeneous. In heterogeneous matrices, beads often aggregate in regions of higher matrix density and float in regions where matrix substrate is not present, making image analysis difficult. This study proposes a unique method of image analysis that does not require the presence of beads, and can be used to analyze the difference in deformation angles vs. distance from the cell membrane. This method established evidence for discontinuity in the mechanics of the matrix. In a heterogenous matrix with large pore sizes, bending force is heavily modulated by the fiber network, and does not follow a continuous $1/r$ trend, where r is the distance from the cell.

Nicholas Groves grew up in Jacksonville, Oregon and graduated from South Medford High School. In 2009, he attended Oregon State University so he could be closer to Mt. Hood for the sweet powder. Two years of tireless snowboarding, a year of nothing but minimum wage work, and a brief existential crisis later, Nick decided that physics was his Huckleberry. He is now expected to graduate spring 2016 with a B.S. in physics with an option in biophysics and minors in mathematics and philosophy. Next year, Nick will attend the University of Denver's PhD program in molecular and cellular biophysics, and hopes to snowboard a lot. In his free time, he also enjoys cycling and hikes with his wife Danielle and two dog-children, Finny and Zo.

James Compeau

High-field Terahertz Spectroscopy of Optically Excited Gallium Arsenside

High field time-domain terahertz spectroscopy (TDS) is used to determine the time dependent transmission and the time-delay and optical-power dependent conductivity of a wafer of gallium arsenide (GaAs). Gallium arsenide is a direct band-gap semiconductor and has potential as a computer processor component. Analysis of the transmission of terahertz (THz) frequencies (10^{12} Hz) through GaAs yields the conductivity of the metal at high strength fields and high frequencies. THz radiation is pulsed into the wafer and is absorbed by free carriers. The transmission of the THz radiation is related to the conductivity of the metal via the thin film Fresnel formula.

It is observed that high power optical excitation lowers transmission of the THz radiation, thus increasing optical power increases the material's conductivity. Positive time delay (optical pulse hitting the wafer after the THz pulse) has shown not to significantly affect the transmission of the THz pulse, or the conductivity of GaAs. A delay of 0.0 ps (optical pulse hitting the wafer at the same time as the THz pulse) slightly increases THz transmission and decreases conductivity from the negative delay. 1.0 ps delay follows the same trend as the 0.0 ps delay. The delay of 3.0 ps slightly decreases transmission of THz radiation from the 2.0 ps delay, and increases conductivity of the wafer.

James Compeau grew up in Ashland, Oregon, and graduated from Ashland High School in 2012. He decided to major in physics at Oregon State University, aiding in research for both the physics and engineering departments. After graduating with a bachelor's degree in 2016, James hopes to enter the physics master's program at Portland State University, and to go on afterward to obtain a PhD in astrophysics.

Jeremy Rath

Organic Semiconductors: Incorporating Xylindein into (opto)Electronic Devices

This research investigates the electronic properties of a fungi-derived pigment, xylindein as a novel sustainable material for organic electronics. Xylindein molecules were characterized in solution and in film. Absorption spectra and (photo)luminescence spectra were taken at various excitation wavelengths.

Xylindein's molecular properties were computed with the Gaussian 09 software suite. Pentacene and peri-xanthenoxanthene were used as references for the reliability of the computations. Thin film devices were made to measure the (photo)conductivity at various excitation wavelengths. A lower limit for the charge carrier mobility was estimated to be 0.2 cm^2/(Vs). Xylindein shows promise for use in both single-component and donor/acceptor solar cells.

Jeremy Rath grew up in Welches, Oregon and was homeschooled until the age of 15. He then attended Mount Hood Community College for two years. While there, he worked as a math, physics, and chemistry tutor. He transferred to Oregon State University in 2013 in pursuit of two Bachelors of Science, one in mathematics and the other in physics. At OSU, Jeremy has worked as an undergraduate teaching assistant and as an undergraduate research assistant in the lab of Professor Ostroverkhova. Jeremy is attending the PhD physics program at Northwestern University in the fall of 2016.

Gregg Stevens

Characterizing a Coupled Photodiode-LED System for Neuro-Sensing Applications

I investigate the feasibility of a micron-sized biosensor designed to measure neural activity. The circuitry of the biosensor is composed of graphene, some photodiodes, and an LED. Many of these biosensors would be injected into a subject's brain, and when powered by near-infrared light, they would glow in response to a neuron's action potential. A model for the circuitry of these biosensors is developed and tested to predict the behavior of the biosensor. The ratio of optical output power to optical input power is greatest when the resistance of the graphene is minimized. However, the signal-to-noise ratio is better when the graphene has a higher resistance. The trade-off between these two goals is optimized by a specific resistance value that provides the greatest sensitivity of the instrument. In a test run, this model achieved a 13% energy conversion rate. This efficiency could be increased by using higher-quality components. These micro-biosensors could solve several of the current challenges facing neuro-sensing technology, including measuring the behavior of a single neuron.

Gregg Stevens began his undergraduate education at Central Oregon Community College, studying science, engineering, and math. He found enjoyment in physics there because of its answers to practical and theological questions. In 2014, Gregg transferred to Oregon State as a Ford Scholar to continue studying physics. During his time at Oregon State, he has researched with Dr. Ethan Minot, tutored, and volunteered for physics outreach. After graduation, Gregg will pursue a Master's degree in Business Administration.

Brendan Vischer

Free Energy of a Liquid

Analytic models using renormalization methods to approximate the free energy of fluids have been developed, but there is currently no way to investigate the intermediate steps of the approximation. We present a computational method to determine the free energy contributions of each length scale by exploiting both the behavior of the critical fluid and the periodicity of Metropolis-Hastings Monte-Carlo simulations. We further detail a method by which to compute the "absolute" free energy, including both the ideal gas free energy and the excess free energy. We further present an application of this method to the well-research square-well liquid near the critical region. We find that the square-well liquid is well-characterized by a base cell length of $L_0 = \sqrt{2}\sigma$ by establishing liquid-vapor coexistence between scaled temperatures. $5 \leq T < .75$.

Brenden Vischer graduated from Grants Pass High School in 2012 and enrolled in Oregon State University for the following fall term. Entering as an Electrical Engineer, he decided to switch majors to Physics midway through his sophomore year, and has not looked back since. Brenden will be entering the Oregon State University graduate program next fall to pursue a Ph.D. in Physics.

Samuel Grimm

Crystal Morphology and Dimensionality Determine the Electronic Response in Novel Semiconducting Materials

Crystal morphology and dimensionality of single-crystal semiconducting materials can have dramatic effects on the optical and electrical properties. Organic photovoltaic (OPVs) materials and fluorinated graphene folds are two materials that show these dependencies. Anthradithiophene (ADT), is an OPV that can be functionalized with different side groups to form different crystal stacking. Photoconductance measurements were taken on three different morphologies of ADT: ADT-TES-F, which exhibits 2D π-stacking, ADT-TSBS-F, which has a 1D sandwich-herringbone stacking, and amorphous ADT. Confocal scanning was used to spatially resolve the photoconductance of the three different morphologies. In the amorphous sample, the photoconductance was uniform over the sample, but experienced quenching over the gold substrate. However, the crystalline samples showed enhanced photoconductance at the interface between the gold and glass substrates. This suggests that the electron-hole pair separation is primarily entropically driven, rather than by the classic photovoltaic charge separation. The interface breaks the symmetry of the crystal samples aiding the separation of the electron hole pairs, while, in the amorphous sample, the disordered molecules already provide the entropy needed for separation.

Fluorinated graphene folds are a new material not previously published. The folds have a width on the order of tens of nanometers making them a quasi-one dimensional material. Using preliminary images from Cornell University, including pump-probe and SEM images, a list was made of 15 devices that may be functional. By comparison of resistances between electrodes on the devices, two connected devices were identified. Electrodes connected by a fold showed resistances on the order of 10^5 Ω, where as the unconnected devices had resistances on the order of 10^7 Ω and higher. Attempts were made to spatially resolve the photocurrent using confocal photocurrent scanning. However, noise in the setup drowned out the response of the fold and prevented the photocurrent from being resolved.

Sam Grimm grew up in Corvallis Oregon. He homeshooled until 2009 and then graduated from Philomath High School in 2012. Sam then attended Linn-Benton Community College to obtain his Associates of Arts with an emphasis in physics before transferring to Oregon State University. Sam will be graduating with his Bachelors of Science in Physics in June 2016. After graduation Sam will be beginning an internship at Vadient Optics in Corvallis.

Alex Peterson

The Thermal Conductivity and Diffusivity of Thin Films Using Time Domain Thermoreflectance Experiments

Time Domain Thermoreflectance (TDTR) is an experimental method of finding the thermal conductivity of thin film materials. TDTR can be used to find the thermal conductivity of a thin film layer in a multi-layered sample, such as thin films on a substrate. Before using TDTR to measure the thermal conductivity of materials with unknown thermal properties, the experimental method must be calibrated using materials with known conductivities. The TDTR experiment was able to verify a conductivity within 10% of the known conductivity. This experimental method may be used for verifying the conductivity of amorphous thin film materials.

Alex Peterson graduated in June 2010 from Aloha High School in Beaverton. He then enrolled at Oregon State University in the Physics program. Alex has an interest in a variety of fields of science and history. He enjoys hiking, camping, and kayaking.

Bret Brandner

Implementation of a Comparative Method for Measuring Fluorescence Quantum Yield of Novel Compounds in Solution

Quantum yield is an important, characteristic quantity to be measured for fluorescent compounds. Here, a comparative method between fluorescent compounds in solution is applied in order to measure unknown quantum yields. To do this, an absorption spectrometer was used to measure the absorbances of two different fluorescent quantum yield standards. Then, the integrated fluorescence intensities were obtained via a double monochromator and plotted against the corresponding absorbances, resulting in two calibration curves. The fluorescence quantum yields of cresyl violet and fluorescein calculated via these curves were 0.55 and 0.77, respectively. These are within 2.8% and 2.9% of their respective literature values. The quantum yields of zinc-oxide (ZnO) microspheres and Anthradithiophene-triethylsilyethynyl-fluorine (ADT-TES-F) in solution were then measured. The results for the ZnO microspheres were inconclusive, but the ADT-TES-F trial gave rise to a fluorescence quantum yield value of 0.44. The implementation of this method allows for the easy measurement of quantum yields with reasonable accuracy in the future.

Bret Brandner grew up in Salem, Oregon and graduated from Blanchet Catholic High School in 2012. He began his college career at Chemeketa Community College as physics major. After two years of community college, he transferred to Oregon State University to continue his physics education. He will graduate Spring 2017. He is interested in pursuing a graduate degree in physics at Oregon State University.

Joshua Stahly

Electrical Transport Measurements on the Alloy $Sn_{1-x}Ca_xSe$

Hall measurements can be made on the unstudied alloy, $Sn_{1-x}Ca_xSe$, to determine its electrical transport properties. The $Sn_{1-x}Ca_xSe$ samples were made by laser deposition into thin films and have a variable of calcium concentration x. These samples are approximately 250 nm in thickness, were grown at 366 ° C and are measured with the Van der Pauw four contact method. The Hall apparatus measures the resistivity and Hall coefficient of the material. The carrier density and the Hall mobility are calculated from these values. For x = 0.2 concentrations the carrier density got up to $\frac{10^{20}}{cm^3}$ while the x = 0.1 concentrations went up to $\frac{10^{18}}{cm^3}$ and lower. From these results, as the calcium concentration increases, the resistivity lowers and the carrier density increases. Further measurements of 0.2 concentrations grown at temperatures closer to the 300 ° C will be needed to establish a concrete trend.

Joshua Stahly is a Christian and grew up in the Oregon northwest coast. He has a younger sister and brother, took 11 years of classical piano lessons, played sports throughout middle school and high school and graduated from Jewell School in 2011. After two years at Portland Community College Josh enrolled at Oregon State University as a physics major. When Josh has graduated this spring, he will be getting married and continue to search for a job in the science field. It's unclear whether or not he will attend grad school in the future.

Daniel Speer

Room Temperature Seebeck Measurements of Silicon Wafers and Thin-film Tetrahedrite Derivatives $Cu_{10-x}Ag_xZn_2Sb_3S_{13}$ on Silicon Substrates

The Seebeck coefficients of two thin-film tetrahedrite derivatives $Cu_{10-x}Ag_xZn_2Sb_4S_{13}$ were measured at room temperature on silicon wafers. For *x* values one and three the Seebeck coefficient of 10.2 and 68.0 $\mu V\ K^{-1}$ were found respectively. Combined with conductivity measurements, the thermoelectric power factors were found to be in the range of 10^{-5} to 10^{-7} $Wm^{-1}K^{-2}$. The Seebeck coefficients of alumel, chromel, thin film indium-tin-oxide, as well as n- and p-type silicon wafers were also measured at room temperature as a thermoelectric standard to test the validity of the system.

Daniel Speer grew up in Salem, OR where he graduated from Sprague Highschool. He started his college career at Montana State University in their architecture department. After his first year he switched over to physics and never looked back. He spent his third year of school at the University of Sheffield in Sheffield England where he worked on a gravitational wave research project. After returning from England, Daniel transferred to OSU where he remained to finish his degree. He has just started career as an engineering sales representative selling HVAC units for Airefco in Tualatin, OR.

Evan Peters

Data Driven Study of Neutron Response in MINERvA using Quasielastic Neutrino Scattering

Understanding how particles behave in detectors is a critical part of analyzing data from neutrino experiments. There are methods in place to determine charged particle behavior in scintillator material, but neutral particles such as neutrons are more difficult to characterize. The purpose of this project was to calibrate methods for predicting neutron behavior in quasielastic antineutrino scattering (QE) events in the Minerva detector. This involved applying kinematics equations to model the properties of outgoing neutrons in QE scattering, then adding modifications to improve the model's correlation to neutrons in data. These kinematic neutron models were first compared to neutrons in Monte Carlo simulations, and then energy ``blobs'' that represent neutron scattering in real experimental data. After filtering events for neutron energy, deviation from expected angle, and distance from the interaction vertex, two different potential calibrations of 30\% energy scaling and 39 MeV energy offset were discovered for the kinematic neutron. A region of good approximation was also identified, although more real data will be necessary to finalize calibration of the kinematic model.

Evan Peters transferred to Oregon State upon finishing his associates at Portland Community College. After a captivating experience in the modern physics class, he began work on a double major in physics and nuclear engineering. In his time at OSU he has worked on experiments including the OSU HTTF, the DIII-D fusion facility, and on MINERvA data analysis where his present work is. He has summer plans to work on supercomputing and computational physics at LANL. In his free time he helps with physics outreach and plays piano for captive audiences on campus. He will get a graduate degree eventually pending an exciting project to work on.

Mitchel Elliot

Solving for the Ground State Energy of a Noninteracting Electron Gas Using the Density Operator

An extremely simple kinetic energy functional is constructed using the density operator formalism. The functional results in ground state energies for quantum systems of an inhomogeneous electron gas. The kinetic energy of the system is minimized computationally, using the variational method. The system in question includes at most three electrons. The results agree with the expected electron charge distributions of a noninteracting electron gas. This approach has the potential to aid electronic structure calculation when generalized to systems of *N* electrons, without the need to solve Schroedinger's equation.

Mitchel Elliott grew up in Beaverton, OR and graduated from Beaverton high school in 2011. He developed a passion for math and physics after using a scanning electron microscope in high school chemistry. Eager to learn more applied math, he enrolled as a physics major after no formal physics education in high school. In his third year he became mesmerized by the physics of digital and analog electronics. He decided to TA for the upper division electronics lab the next year. He hopes to find work in quantum computing after graduating with a Bachelor of Science in Physics. In his free time he enjoys playing guitar and listening to music.

Jayde Templin

Experimental Apparatus for Measuring Heat Memory of Drosophila Melanogaster Utilizing Thermal Electric Devices

A detailed report on the design, construction and operation qualities of an experimental apparatus to observe heat memory in Drosophila Melanogaster. Apparatus incorporates an array of thermoelectric devices, which are all regulated with a microcontroller based control system. The control system utilizes an AD592 temperature sensor and a PID control algorithm to maximize performance. Power is supplied to the system by a 30 Amp 12 Volt switching power supply that is regulated using a L298N h-bridge controlled via a Pulse Width Modulation (PWM) signal.

Jayde Templin graduated from Mountain View High School, Bend Oregon, in 2010. Throughout his childhood he was always interested in figuring out how things work. This led him to a study of physics and engineering in collage. After collage he plans to gain experience in the private sector, and eventually become an entrepreneur starting his own engineering firm. In his free time he likes tinkering, backpacking and has a special love for spelunking.

Previous Presentations Honors College

Sam Kowash

The Lag–luminosity Correlation in Time-resolved Episodes of Long Gamma-ray Bursts

Advised by Davide Lazzati

Gamma-ray bursts are immense flashes of high-energy radiation originating from stellar death processes in distant galaxies. Many bursts exhibit a time delay between the high- and low-energy components of their emission, known as the spectral lag. For the class of long gamma-ray bursts, there is a known relationship between the spectral lag and the peak luminosity of the burst, which can otherwise be difficult to determine. The spectral lag is generally measured through cross-correlation analysis of the entire GRB light curve, but many bursts have a complex temporal structure which may include distinct sub-events of varying intensity.

We present a time-resolved cross-correlation method for investigating the lag–luminosity correlation between slices of gamma-ray bursts, and apply this method to a sample of long GRBs detected by the BATSE gamma-ray observatory. The analysis produces a lag–luminosity correlation parameter for each burst in the sample, and we discuss the statistical behavior of these results. In particular, we consider the extent to which the whole-burst lag–luminosity correlation extends to these intra-burst measurements.

Sam Kowash grew up in Portland, OR and graduated from Cleveland High School in 2012. During his four years at Oregon State University, he has been active in the Society of Physics Students, including a year as the treasurer of the OSU chapter. His interests in physics include particle theory and gravitation. Outside of school, Sam spends most of his time reading and playing guitar. He will graduate from OSU with H.B.S. degrees in physics and mathematics this spring and begin a Ph.D. program at the University of Washington in the fall.

Upcoming Presentations Summer 2016

Rafid Chowdhury
Advised by Henri Jansen

Michael Goldtrap
Advised by Corinne Manogue

Scott Kelley
Advised by Tom Giebultowicz

Christopher Rosenow
Advised by Henri Jansen

Cole Schoonmaker
Advised by Henri Jansen

Jayde Templin
Advised by Tom Giebultowicz