INTERACTIONS

DEPARTMENT OF PHYSICS 2012

Anonymous Donors Establish Physics Undergraduate Enrichment Fund

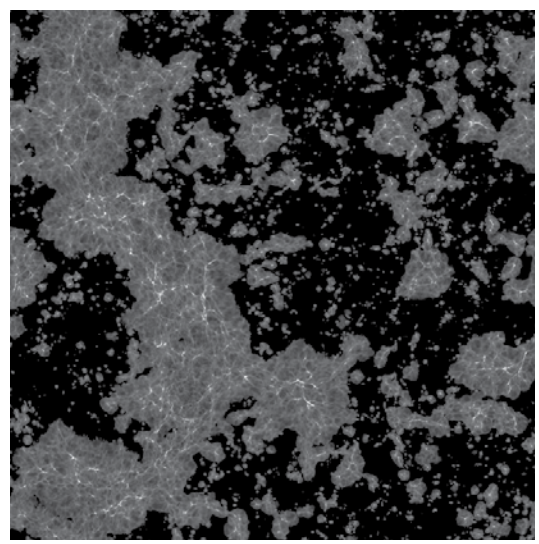
A Carnegie Mellon family, in recognition of the quality of their student's physics education, has established a fund to support undergraduate activities beyond the classroom. This fund will allow the Department of Physics to employ more undergraduates in research-related positions and will support other undergraduate activities, such as student clubs and events and travel to physics conferences. Our generous donors hope that this fund will inspire giving by other friends of the department who are interested in enriching the undergraduate experience. If you would like to contribute to this fund, please include the designation "Physics Undergraduate Enrichment" when making your gift to Carnegie Mellon. General donations to the department without this designation will be used to support undergraduate and graduate programs.

The Universe in a Computer

Hy Trac

Computational cosmology has advanced considerably in four decades, starting with simulations having only a few thousand particles interacting gravitationally to state-of-the-art simulations with tens of billions of resolution elements having several different types of interactions. To put the universe in a computer, we have to solve the physics of gravitation, fluid dynamics and radiative transfer to model the evolution of dark matter, gas, stars, black holes and radiation. Interesting microphysics, some well understood (e.g., atomic transitions), others still unknown (e.g., star formation), can also be included. Furthermore, the physics are solved in an expanding space-time. In general, the expansion could slow down due to the attractive force of gravity or speed up due to some mysterious repulsive force, which we call dark energy.

Many specialized algorithms have been developed and applied for cosmological simulations. For example, there are N-body methods for collision-less dark matter dynamics, grid-based Eulerian or particle-based Lagrangian schemes for collisional gas dynamics, and raytracing techniques for radiative transfer. Numerical modeling has also benefited from the rapid development in supercomputing technology and capability. Together, these advancements enable increasingly larger and more realistic simulations to be run and studied.



A visualization of cosmic reionization in a hydrodynamic + radiative transfer simulation. Early generation of stars and galaxies produce ultraviolet radiation that dissociate electrons from the neutral hydrogen gas in the universe.

My research in cosmology and astrophysics often incorporates supercomputing simulations. Starting in graduate school at the University of Toronto, and during my post doctorates at Princeton and Harvard, I have developed and applied my own N-body, Eulerian hydro and raytracing radiative transfer codes to simulate how structures form and evolve in the expanding universe. I am particularly interested in complex problems involving the gas, stars, galaxies and clusters of galaxies that provide the color for our picture of the cosmos.

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Simulating Cosmic Reionization

One continuing project I work on involves using simulations to understand the process of cosmic reionization, which is now a frontier topic in cosmology with vast scientific richness for theoretical and observational exploration. What uniquely marks the epoch of reionization (EoR) is the emergence of the first luminous sources: stars, galaxies and quasars. It is possibly the only time that these objects directly alter the state of the entire universe. Ultraviolet radiation from the sources is energetic enough to dissociate electrons from neutral hydrogen atoms, converting the cold and neutral primordial gas into a warm and highly ionized one. Consequently, this impacts the formation of later generations of galaxies. The distant observational signals have the promising potential to not only tell us how the first generation of stars and galaxies formed, but also provide strong constraints on the fundamental parameters of the cosmological model. With collaborators, we have already shown that the imprints of reionization, in particular in the gas density and temperature fields, are different than previously assumed, and can potentially be observed in quasar spectra from the Sloan Digital Sky Survey (SDSS).

Discovering Galaxy Clusters

Galaxies are not randomly distributed in the universe, but rather they are generally found close to one another. Galaxies also collect in pairs, triplets and even in the hundreds or thousands. Galaxy clusters situated in massive dark matter halos are the largest gravitational bound systems in the universe. The largest known system has a mass over 1,015 times the mass of our sun, and over 1,000 times the mass of our galaxy. For decades, astronomers have tried to count the number of clusters as a function of mass and time, for their abundance can reveal how much dark matter and dark energy exist in the universe. One modern way of detecting clusters is through the Sunyaev-Zel'dovich effect, a distortion in the temperature of the cosmic microwave background (CMB) radiation as the photons get scattered by hot intracluster gas. I am a member of the science team for the Atacama Cosmology Telescope (ACT) project, which uses a 6-meter primary mirror telescope to observe at three frequency channels. We have detected galaxy clusters in CMB maps and have already started placing constraints on parameters of the cosmological model. Many more new clusters will be discovered over the next few years of operation.

In the Works

With the start of the Petascale (1,015 operations per second) computing era, comes a renewed emphasis on code development. I have started a new project to develop a state-of-the-art cosmological code that combines the advantages of moving-mesh (MM) and adaptive mesh refinement (AMR) algorithms. In the traditional MM approach, an initial Cartesian mesh is continuously deformed to improve dynamic range where and when the action takes place. With the addition of AMR, a hierarchy of refinement meshes and moving-meshes allow unlimited dynamic range in principle. It is an exciting time for computational cosmology, and I hope to share that with the current and future generations of students and postdocs.

Gregg Franklin

From the Department Head

I am proud to announce that three new assistant professors have joined our department since the last edition of *Interactions*. These include Prof. Hy Trac, formerly a Harvard-Smithsonian Center for Astrophysics researcher, who joined us last year; you can read about his research activities in this newsletter. Prof. Shirley Ho and Prof. Rachel Mandelbaum joined us this fall. Before joining us, Prof. Mandelbaum was a researcher for Princeton University's Department of Astrophysical Sciences and Prof. Ho held both the Chamberlain and Seaborg Fellowships at Berkeley. All three are now members of the department's Bruce and Astrid McWilliams Center for Cosmology.

This edition of *Interactions* focuses on undergraduate research. Although we do not require a formal thesis project as part of our undergraduate degree program, we strongly encourage our students to participate in research. To help prepare them for activities outside the classroom, our undergraduates are introduced to a variety of physics research fields in our sophomore colloquia series and they see more in-depth presentations during our junior colloquia. To help our students find research opportunities, Prof. Kunal Ghosh, our Assistant Head for Undergraduate Affairs, maintains a database of possible research topics, but many of our aggressive students just show up in faculty offices hunting for research opportunities. In some cases, they come with their own ideas for research initiatives. We find that more than 90% of our students take advantage of research opportunities and internships by the time they graduate. To hone their communication skills and share their research experience with their colleagues, our students present their work at the department's annual poster session held each spring.

Five students have contributed articles on their research to this newsletter. They include Maxwell Hutchinson, who pursued his own research idea as a freshman and went on to work on other computational-related activities throughout his time with us. Matt Duescher's ChargeCar research was done with members of the Robotics Institute. Charles Swanson and Greg Bernero worked on two different projects involving the detection of cosmic rays while Jason Rocks pursued theoretical investigations of lipid membranes properties. This sampling of projects is intended to show the breadth of challenges taken on by our students.

Calling All Physics Alumni!

As is often the case in other things, Carnegie Mellon alumni are stronger when they are united. Whether you live in Pittsburgh or on the other side of the globe, you can stay connected as a member of the Carnegie Mellon online community. The online community offers alumni and current students the opportunity to connect with old and new friends, register for events near you or on campus and network professionally. You may access services such as email forwarding, which allows you to create a permanent email address identifying yourself as a CMU alumnus/a. Finally, your participation will help the Department of Physics stay in touch with you and keep you posted on department news.

To access the CMU online community, you will need to register and create an account. (If you had an existing account prior to Nov. 2011, you must create a new registration.) You will need your 10-digit Personal Identification Number (PIN), which can be found on the address label of your Carnegie Mellon Today magazine as well as at the bottom of emails you receive from the Alumni Association. In November, when the site officially launched, an email featuring your PIN was also sent to you.

We want to stay in touch with you, so please take a moment and join your fellow physics alumni as members of the CMU online community today.

ACCOUNT CREATION

Follow These Steps:

1. Visit alumni.cmu.edu/registernow
2. Search for your name
3. Select your name in the search results
4. Enter your ten-digit PIN*
5. Create your new password

*Your ten-digit PIN can be found at the bottom of emails from the university as well as on your Carnegie Mellon Today mailing label.

Questions? Contact us at **alumni-online@andrew.cmu.edu.**

Astronomy Podcasts

During the last year and a half, our astronomy instructor, **Diane Turnshek**, has uploaded over a dozen of her astronomy podcasts to the website 365DaysofAstronomy.com. The 365 Days project began in 2009, the International Year of Astronomy, and has published daily podcasts since then (a transcript, an audio file and an RSS feed). The podcasters hail from around the globe. Five times, groups of students from Introductory Astronomy have podcasted on this site under Diane's tutelage. The subjects included a discussion of the baloney of 2012 end-of-the-world scenarios, the questionable value of spectacle in science TV shows, Eastern influence on astronomy, black holes and the Drake Equation. The topics for Diane's podcasts range widely—light ("Astronomy Vacations" and "Stargate Universe and the CMB"), historical (a tribute to CMU Professor Truman Kohman), political (Congressional Visits Day with the American Astronomical Society) and educational ("Wonders from Class" series). Her latest is an interview with Dr. Michael Wood-Vasey (U. Pittsburgh), the new spokesperson for the Sloan Digital Sky Survey III. Feel free to contact her with ideas and interview subjects for future podcasts.

Diane Turnshek

http://365daysofastronomy.org/

IN MEMORIUM
Walter James Carr, Jr., Ph.D. (S’50)

The Department of Physics lost a distinguished alumnus recently. Walter James (Jim) Carr Jr. (S’50) died at his home in Pittsburgh on November 16, 2010, at age 92. He is survived by his wife, Winifred W. Carr, nee Schultz (A’48), son James L. Carr (S’78) and his wife Kathleen Carr (S’77), son Robert D. Carr (S’84, S’87, S’95), grandchildren Jennifer and Matthew Carr, and his brother B. Edward Carr.

After graduating from the Missouri School of Mines and Stanford University, where he earned a master’s degree in electrical engineering, Dr. Carr was recruited by Westinghouse Electric Corporation to work in its research laboratories. While at Westinghouse, he expressed a desire to study physics to better understand the “why” behind the engineering, and the company agreed to sponsor his graduate studies in the Department of Physics at Carnegie Tech. Dr. Carr conducted research in magnetostriction under Prof. Roman Smoluchowski and earned his Ph.D. in physics in 1950.

During his 44-year career with Westinghouse, Dr. Carr published 63 papers and was awarded 13 patents. In recognition of his contributions to theories of magnetism and for development of the theory of alternating current losses in composite superconductors, the Institute of Electrical and Electronic Engineers elevated him to the grade of IEEE Fellow in 1987. He also became a Fellow of the American Physical Society.

Our Department of Physics takes pride in Dr. Carr’s distinguished contribution to industrial research. In recognition of his passion for both physics and research, Dr. Carr’s family has established the W. James Carr Jr., Ph.D., MCS 1950, Memorial Undergraduate Research Fund at Carnegie Mellon. This endowed fund will provide Small Undergraduate Research Grants (SURG) to students pursuing research projects in physics.

Peter Barnes

Peter David Barnes, the founding member of our medium-energy physics group, died on March 25 at the age of 73. He is survived by his wife, Angela, and their children Alexa, Peter and Diana, eight grandchildren and his brother Frederick.

After completing his undergraduate work at Notre Dame, Peter went on to obtain his Ph.D. from Yale in 1965. Following postdoctoral fellowship at the Niels Bohr Institute and Los Alamos National Laboratory, Peter joined our department in 1968.

While at Carnegie Mellon, he led his group in a series of pioneering experiments at the Los Alamos Meson Physics Facility, the Argonne ZGS and the Brookhaven AGS. By the 1980s and ’90s, the group specialized in studies of the role of the strange quark in nuclear physics, performing experiments involving strange-quark production using CERN’s antiproton beam (LEAR) and early relativistic heavy-ion beam at the SPS. Studies of structure of hypernuclei (nuclei with one or more strange quarks) and their lifetimes were performed using kaon beams available at the AGS.

In 1991, Peter left the department to become director of the Los Alamos Meson Physics Facility and director of the MP Division. He served as director of the Physics Division at Los Alamos from 1993 to 2000. During this period, Peter maintained an active research program that covered a broad spectrum of activities, contributing to the efforts of the MINOS, CDMS and PHENIX collaborations.

Throughout his years in leadership positions, Peter combined his insights with his physics and management skills to serve the nuclear physics community. His work as chair of the 1984 DOE panel on the future of electron scattering helped define the foundation of what is now the Thomas Jefferson National Laboratories.

Educational Outreach to Rwanda

“That had better not be a brain!” My husband had developed a reputation for bringing home partially-dissected animal parts from his Anatomy and Physiology class and storing them in Styrofoam takeout containers in our refrigerator. He smiled as he opened the takeout box in his hands and offered me an onion ring.

Two months earlier, Bertin had come home from class with a sheep brain. As we sat together at the kitchen table, he cut into it and consulted his notes. He made a casual comment about sheep: in his native country of Rwanda, sheep kabobs were a popular meal. Why didn’t teachers use leftover parts, like the brain, to teach anatomy? He had taken biology in Rwanda and had studied the parts of the brain, but he had never actually seen one.

Rwanda is a small, developing nation in East Africa. High school teachers lack supplies of all kinds: books, lab equipment and sometimes even chalk. To add to the teachers’ difficulties, the public school system recently switched the language required for classroom instruction. Teachers are now required to deliver all lessons in English, yet many classrooms have only a single copy of a textbook that is written in French. As Bertin and I talked about these problems, an idea formed: we could go to Rwanda and train teachers to build low-cost teaching supplies by utilizing the things that are readily available. In addition, we could collect textbook donations that teachers could use as a reference as they prepared their lessons.

Bertin and I assembled a small team of volunteers who contacted local universities, high schools and publishing companies. Textbooks poured in, including many from CMU physics faculty. We loaded the 4,500 donated textbooks into a 20 foot shipping container and sent them for a six-week journey by sea to Rwanda’s Ministry of Education.

In May, we traveled with our team to Kigali, Rwanda’s capital city, where the Ministry of Education arranged for me to train 79 science teachers. During the training session, I showed teachers how to create lecture demonstrations using the things that they have around them. I began my lesson by holding up an egg and explaining that this inexpensive item could be used to teach a key concept in each subject area: osmosis in biology, emulsion chemistry, impulse in physics and volume in mathematics. With my guidance, teachers went on to develop their own lecture demonstrations using the things that they had on hand.

Our teacher training session and textbook donation was met with overwhelming gratitude, and Bertin and I wish to return to Rwanda to carry out similar training sessions in more remote parts of the country where the need is even greater. Donations for our book drive continue to arrive and our garage is again becoming a science reference library to rival the E&S Library in Wean Hall. We hope to soon be able to send a second shipment of books to Rwanda, with the end goal of supplying every biology, chemistry, physics and mathematics teacher in the country with a textbook of their own.

Special thanks to the Provost’s Office, the MCS Dean’s Office, the CIT Dean’s Office and Allison Park Church for their financial contributions toward the cost of shipping. If you’d like more information about how you can help science teachers in Rwanda, please contact Michelle Hicks Ntampaka at ntampaka@cmu.edu.

Victor Bearg Museum Anniversary

Visitors to campus, as well as current students, may be treated to an impressive display of antique scientific instrumentation for research and teaching, which has been compared favorably to displays in the Smithsonian Institution. But unless they are taking physics classes, or touring the undergraduate physics laboratories, they may have to go out of their way to find it. 2012 marks the 10th anniversary of the Victor M. Bearg Physics Museum, located near the undergraduate physics laboratories, on the A-level of Doherty Hall. Made possible by the generosity of Victor M. Bearg (S'64), and curated by Barry Luokkala (S'01), the museum features original laboratory furniture and equipment used by the very first students at the Carnegie Technical Schools, as well as photographs of the undergraduate physics laboratories as they appeared in the early 1900s. Displays are arranged by topic, and include the measurement of basic physical quantities (length, mass, temperature, pressure), light and optics, electricity and magnetism, and atomic physics. One exhibit shows the gradual evolution of instrumentation for measuring current and voltage, beginning with simple d'Arsonval analog meter movements from the late 19th century, and progressing to modern digital multimeters.

A favorite item, which is frequently removed from the display for use as a classroom demonstration, is an important artifact from the history of modern physics. The famous Stern-Gerlach experiment provided the first direct experimental evidence that the spatial orientation of the magnetic moment of an atom is quantized. Originally performed in the early 1920s, the experiment involved passing a beam of atoms through a highly non-uniform magnetic field. The pole tips of the Stern-Gerlach magnet found their way here, when Otto Stern and his associate, Immanuel Estermann, came to Carnegie Tech at the invitation of President Baker in 1933. Stern, who received the Nobel Prize in Physics in 1940, remained at Carnegie Tech for a relatively short time. Estermann, however enjoyed an extended career here. One of his graduate students, Simeon Friedberg (S'51) later became head of the physics department. The original Stern-Gerlach magnet pole tips were preserved in Professor Friedberg's office until his retirement, when they became part of our museum display, along with a number of antique optical instruments from Professor Friedberg's personal collection, donated by his family.

The museum also features a collection of memorabilia from NASA's Ranger Project, donated by another of our alumni, Joseph Staniszewski (S'50). Mr. Staniszewski designed the video camera system flown on the Ranger probes, which were a prelude to the Apollo program. Along with the original prototype video camera and power unit, the display also includes original footage transmitted by the Ranger's video cameras, during the last couple of minutes before the probe (intentionally) crashed into the lunar surface. The film was converted to DVD, which plays continuously in the museum display.

The Victor Bearg Physics Museum is open at all hours when Doherty Hall is open, and admission is free.

Maxwell Hutchinson

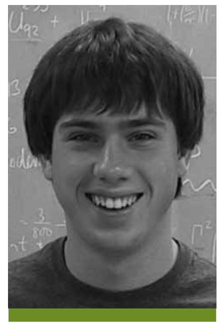
While at Carnegie Mellon, I was constantly engaged in research. Freshman year, I had a SURF with Prof. Franklin to simulate and design an idea for an electromagnetic linear accelerator. Sophomore year, I worked at the Pittsburgh Supercomputing Center (PSC), which is connected to CMU through the physics department, on a number of computational physics codes. Junior year, I began working with Prof. Widom on quasicrystals, boron and density functional theory (DFT), and am still involved in those efforts. Senior year, in addition to the work with Prof. Widom, I studied Ising models with Prof. Swendsen and two fellow students, Robert Lee and Karpur Shukla. We've had much better luck with quasicrystals and DFT methods applied to boron, so let me tell you a little bit about them.

Quasicrystals are solid structures that lie somewhere between glasses (amorphous) and crystals (periodic) in that they lack translational periodicity, but maintain rotational symmetries and other long range order. Their experimental discovery by Dan Shechtman won the 2011 Nobel Prize in Chemistry. As physicists, we strive to find some simple model of the quasicrystal structure, with the "random tiling model" being the most popular. In this model, the structure is represented by a space-filling, non-overlapping tiling. Our challenge is, given a set of tiles and a polygon, to count the number of ways to tile the polygon. The solution, in terms of the characteristic length of the polygon, grows super-exponentially. We focused on octagonal regions, and edge-length 5 was the previous largest result (29675561010827848 0324496). We were able to use 1TB of shared memory for three weeks on the Blacklight supercomputer at the PSC to solve the problem through edge-length 8 (1195803 0460032216692321999491102528884665618728333544765499 25).

The full sequence can be found on the Online Encyclopedia of Integer Sequences #A093937.

Density functional theory is a widely used, approximate quantum mechanical model electronic systems. Within DFT, one can choose different types of functionals, generally with a trade-off between computational complexity and accuracy. We were interested in applying hybrid functionals, which are very accurate but very costly, to the problem of the structure of boron at low temperature. This problem has a rich history and, despite its apparent simplicity, is yet unresolved. To enable the practical application of hybrid functionals to this problem and others, we rewrote the hybrid functional capabilities of VASP, a popular DFT code, to run on Graphical Processing Units (GPUs). Our GPU version runs about an order of magnitude faster than the conventional CPU implementation. We hope that this will enable the use of hybrid functionals on other problems that would have been prohibitively expensive to run on the CPU. For more information, see arXiv:1111.0716.

Editor's note: Maxwell Hutchinson graduated in May 2011, and is currently pursuing a Ph.D. in physics at the University of Chicago.



Matt Duescher

My undergraduate research was for the ChargeCar project, headed by Professor Illah Nourbakhsh and Gregg Podnar. The purpose of ChargeCar is to design affordable conversions of cars with internal combustion engines into plug-in electric commuter vehicles through the intelligent use of existing technologies. Although the project lives under the banner of the school of robotics, I was able to contribute using a variety of skills and knowledge that I had acquired as a physics major. My work centered around producing mathematical models of our cars in order to simulate their performance and optimize their management of the energy stores. This required me to draw heavily from my knowledge of mechanics, but also included aspects of electricity and magnetism and thermal physics. However, this was not all I needed to do my job; the cars were not optimal systems like I learned in classes, so I learned about the nonlinear behaviors of real systems and the complexities and ambiguities of battery physics and engineering.

One exciting consequence of my role on ChargeCar was that the optimization helped inform design decisions on the real prototypes. Additionally, the model was integrated into a website that, given information about a user's car and a GPS recording, would estimate how an electric version of the user's car would perform versus a gas-powered one. All of this work also contributed to the production of a couple of papers, including a conference selection for IEEE this summer.

Working on ChargeCar was a nice opportunity for me, because it allowed me to broaden my horizons as a student by working on a research project with elements outside of my normal studies. This project was an exciting one to be a part of as well, because it led to real prototypes and the growth of a community surrounding the conversion of gas-powered cars to electric. I found my efforts both interesting and rewarding during my time on ChargeCar, and it made for a great research experience.

Editor's note: Matt Duescher graduated with a Bachelor of Science in Physics in May 2011.

Charles Swanson

My research was with the TAUWER collaboration, who want to build a detector on the side of a mountain to capture tau neutrino decay products coming up through the Earth. I stayed here at CMU for the summer of 2011 in order to work for Professor James Russ to evaluate the hardware that was suggested for use in the detector.

Silicon photomultipliers (SiPMs) are the main revolution in the project. Compared to photomultiplier tubes, they are smaller, less expensive, more energy-efficient and higher-resolution. However, extraordinary claims require extraordinary proof: in order to convince funding committees that the SiPMs are the better option, they needed to be extensively tested. Thus, Prof. Russ' graduate student and I evaluated the SiPM behavior in response to simulated particle interactions, stimulated particle interactions and finally actual cosmic rays.

My personal project was an algorithm to increase time resolution of the particle interactions. The design of the particle detectors require sub-nanosecond resolution between two particle interactions, and though the rise-time (and therefore time resolution) of an SiPM is smaller than that of a photomultiplier, it is still on the order of ten nanoseconds. My algorithm took into account the entire waveform that was the output of the SiPM to better deduce the time at which the particle entered the scintillating crystal.

Professor Russ then took my algorithm to Fermilab and analyzed some test data. My algorithm resulted in data more precise by a factor of two than that of the current timing algorithms in use. It is currently being used by a PET group, and Prof. Russ has suggested I publish it.

Jason Rocks

After my research last summer concerning defects in liquid crystals, I decided that I wanted to continue performing research during the semester in the field of soft condensed matter physics. I heard Professor Deserno give a lecture last spring about theoretical biophysics and decided that I wanted to learn more about this unique area of physics. I approached Professor Deserno at the beginning of the fall semester and was given a project that has been both challenging and rewarding, exposing me to areas of physics that I would not have encountered during my undergraduate coursework.

My current project has focused on understanding the energetics of lipid membrane deformations during cellular fission and fusion events. These events are of interest because they are vital for numerous cellular processes such as cell division, vesicular trafficking, endocytosis, exocytosis and viral infection. Specifically, I have been working on a method to determine the Gaussian bending modulus of lipid membranes, a quantity that has only been measured in a very limited number of cases. Understanding this material parameter is important because its energetic contribution during fission and fusion is very large. Recently, Professor Deserno's group proposed a highly accurate method to measure the Gaussian modulus for single-component lipid membranes in simulation. In order to make this method biologically relevant, my project has been to incorporate a model for mixed membranes. The main difficulty has been incorporating the effects of preferential lipid adsorption at membrane open edges. I am still working on this problem and hope to have results by the end of the academic year. This project has been very exciting and has given me a great opportunity to practice my skills as an independent researcher.

Greg Bernero

I did research with another undergraduate student from May – December 2011 under Professor Reinhard Schumacher. We explored the possibility of a correlation between atmospheric conditions and surface-level cosmic ray muon flux. We worked with and expanded upon an existing Modern Physics Lab experiment designed to measure muon decay times. We incorporated barometers into the data acquisition system in order to measure the air pressure in the lab. We used a detector to record the muon decay events, and also recorded the air pressure, temperature, humidity and other weather data at the time of the events. We can bin the events in hour-intervals to further analyze and graph the data.

I became involved in the project by emailing several professors in the department asking if they had any projects for undergraduates. Professor Schumacher replied, telling me about the idea. We were not funded by a grant or any other source, but the department already had nearly all of the equipment we needed. We are currently analyzing the data we took over the course of the project, and there appears to be a strong anti-correlation between the air pressure and the muon flux. We will be writing a formal paper and presenting a poster in the spring.

Faculty Honors

2009

Roy Briere and ***John Nagle*** were named Outstanding Referees by the American Physical Society.

Kunal Ghosh received the "You Make the Difference Award" for the second year in a row, presented by the Carnegie Mellon Panhellenic and Interfraternity Council, November 2009, for "dedicated efforts to students, demonstration of superior leadership, inspiration to others and contribution to our success as students."

2010

Alex Evilevich received the Hagberg Prize ($28K) from the Swedish Royal Academy of Science.

Gregg Franklin received the Carnegie Mellon University's Undergraduate Advising Award, and was appointed a fellow of the American Physical Society.

Kunal Ghosh received the "You Make the Difference Award" for the third year in a row, presented by the Carnegie Mellon Panhellenic and Interfraternity Council, November 2010, for "dedicated efforts to students, demonstration of superior leadership, inspiration to others and contribution to our success as students."

Robert Griffiths was named an Outstanding Referee by the American Physical Society.

Sara Majetich received the Carnegie Award for Emerging Female Scientist.

Stephanie Tristram-Nagle received the Pittsburgh Foundation Charles E. Kaufman Science Award ($50K).

Degrees Granted in 2010

Doctor of Philosophy in Physics

Elisa Kay Pueschel
Measurement of the CP Violating Phase sin2betas using Bs -> J/Psi Phi Decays at CDF
Advisor: Manfred Paulini

Graduated in December 2009
John Merritt Bulava
An Improved Variance Reduction Technique for Stochastic All-to-All Quark Propagators in Lattice QCD Spectrum Computations
Advisor: Colin Morningstar

Graduated in August 2009
Haijun Gong
Computational Models of Protein Sorting in the Golgi Apparatus
Advisors: Russell Schwartz, Michael Widom

Graduated in 2009
Gabriel Alexander Altay
Cosmological Radiative Transfer
Advisor: Rupert Croft

Jason E. Galyardt
Correlations in Bottom Quark Pair Production at the Fermilab TeVatron
Advisor: James Russ

Jianjun Pan
Supramolecular Organization of Alamethicin in Fluid Lipid Membranes
Advisor: John Nagle

Doctor of Philosophy in Physics and Master of Science in Colloids, Polymers and Surfaces 2009
Yuli Wei
Dynamic Wetting of Viscous Newtonian and Visco-elastic Fluids
Advisors: Stephen Garoff and Lynn Walker

Master of Science in Physics
Aristotle M. Calamba
Guowei He
Mingyang Hu
William Paul Huhn
Muwen Kong
David W. Lenkner
Michelle Carla Ntampaka

Bachelor of Science Double Degree in Computer Science And Physics
Alonzo Javier Benavides

Bachelor of Science Triple Degree in Computer Science Mathematical Science and Physics
Jonathan Leonard Long

Bachelor of Science in Physics
Coleman Broaddus
Chih Yueh Chan
Benjamin Joseph Greer
Deena Jiyun Kim
Vikram Vijay Kulkarni
Anastasia Igorevna Kurnikova
Alexander Marakov
Kaitlyn H. Schwalje
Brandon W. Tarbet
Joshua Robert Tepper
Kevin Tian
Matthew J. Urffer
Graduated in August 2009
Henry Kurt Ermer
Sibel Deren Guler
Graduated in December 2009
Sean Martin Gilroy
Grant Hahn Lee
Expected August 2010
Richard Lee
Yuriy Zubovski

Bachelor of Science in Physics, Astrophysics Track
James Alexander McGee

Bachelor of Science in Physics, Astrophysics Track with a minor in Biomedical Engineering
Kunting Chua

Bachelor of Science in Physics with minor in Computer Science
David Scott Schultz

Bachelor of Science in Physics with a minor in Mathematical Sciences
Graduated in August 2009
Omar Emad Shams

Bachelor of Science in Physics with a minor in Philosophy
Matthew Gregory Buchovecky

Bachelor of Science in Physics with minor in Engineering Studies
Justin Gregory Winokur

Bachelor of Science in Physics with an additional major in Philosophy
Matthew Stuart Rowe

Bachelor of Arts in Philosophy with an additional major in Physics
Adam Paul Walker

Bachelor of Science in Computer Science with an additional major in Physics and Robotics
Andrew James Yeager

Triple Degree

Bachelor of Arts in Physics and Master of Art in Literary and Cultural Studies and completed a Bachelor of Science in Business Administration
in December 2008
Alexandra C. Beck

Double Degree

Bachelor of Science Double Degree in Business Administration and Physics
Corey Montella

Bachelor of Science Double Degree in Mechanical Engineering and Physics
Thomas J. Lambert

Bachelor of Science Double Degree in Physics and Mechanical Engineering
Shaun Robert Swanson

Minor in Physics
Philippe Ajoux
Jason Brubaker
Francesco Coco
Charles Cowan
Aaron Daniele
Owen Durni
Daniel Eisenberg
Benjamin Ely
Matthew Goldfarb
Bumki Kim
Manoj Kumar Kintali Venkata
Amelia Lewis
Ravi Mehta
Matthew Morrill
Bradford Neuman
Scott Ridel
Sean Sechrist
Alexander Strommen
Semen Tetruashvili
Geo Thukalil
Yue Peng Toh
Tracey Ziev

Undergraduate Honors

Alexandra Beck
Sigma Xi

Matthew Buchovecky
University Honors

Kunting Chua
University Honors
College Honors
Phi Beta Kappa
Sigma Xi

Luke Durback
University Honors

Benjamin Greer
University Honors
College Honors
Sigma Xi
ACS Scholar

Deena Kim
University Honors
College Honors
Sigma Xi

Vikram Kulkarni
University Honors

Anastasia Kurnikova
University Honors
College Honors
Sigma Xi

Thomas Lambert
University Honors

Jonathan Long
University Honors
College Honors
Phi Kappa Phi

Alexander Marakov
University Honors
Sigma Xi

James McGee
Sigma Xi

Shaun Swanson
University Honors
College Honors

Brandon Tarbet
Sigma Xi
Kevin Tian
University Honors
Phi Beta Kappa
Phi Kappa Phi

Justin Winokur
University Honors
College Honors

Andrew Yeager
University Honors
Phi Beta Kappa
Phi Kappa Phi

Degrees Granted in 2011

Doctor of Philosophy in Physics
Tristan Bereau
Unconstrained Structure Formation in Coarse-Grained Protein Simulations
Advisor: Markus Deserno

Vlad Gheorghiu *(Aug 2010)*
Separable Operations, Graph Codes and the Location of Quantum Information
Advisor: Robert B. Griffiths

Charles Robert Hogg III *(Dec 2010)*
Pattern Transfer from Nanoparticle Arrays
Advisor: Sara Majetich

Jimmy Hutasoit (*Aug 2010)*
Time-dependent Backgrounds in String Theory and Dualities
Advisor: Richard Holman

Shiu Fai (Frankie) Li
In situ Observation of Deformation with High Energy X-ray Diffraction Microscopy
Advisor: Robert M. Suter

Luxmi *(Dec 2010)*
Structural Studies of Epitaxial Graphene Formed on SiC{0001} Surfaces
Advisor: Randall Feenstra

Navodit Misra *(Aug 2010)*
Algorithms for Reliable Computing in Molecular Biology
Advisors: Russell Schwartz, Robert Swendsen

Kei Moriya *(Dec 2010)*
Measurement of the Lineshape, Differential Photoproduction Cross Section, Spin and Parity of the Lambda(1405) Using CLAS at Jefferson Lab
Advisor: Reinhard Schumacher

Diana Marwick Seymour Parno
Measurements of the Double-Spin Asymmetry A1 on Helium-3: Toward a Precise Measurement of the Neutron A1
Advisor: Gregg Franklin

Peng Zheng
High Temperature Langasite Surface Acoustic Wave Sensors
Advisor: David Greve

Graduating in August 2011

Kevin Bandura
Pathfinder for a HI Dark Energy Survey
Advisor: Jeffrey Peterson

Ryan Douglas Dickson
Photoproduction of the f_1(1285)/eta(1295) Mesons using CLAS at Jefferson Lab
Advisor: Reinhard Schumacher

Shiang Yong Looi
Quantum Error Correcting Codes with Graph States and Tripartite Entanglement Structure of Graph States
Advisor: Robert B. Griffiths

Master of Science in Physics
Alexander Scott Bell
Robert Haussman
Dao Ho
Yutaro Iiyama
You-Cyuan Jhang
Kevin Richard Koch
William Levine
Siddharth Maddali
Patrick Mende
Matthew Oborski
Udom Sae-Ueng
Zhen Tang
Tabitha Christine Voytek
Huizhong Xu
Ying Zhang

Bachelor of Science in Physics with Minors in Philosophy and Computer Science
David Andrew Bemiller

Bachelor of Science in Physics
John Joseph Briguglio
Brent Joseph Driscoll
Matthew Norman Duescher
Benjamin R. Ellison
Danielle M. Fisher
Nils Raymond Guillermin
Andrew Austin Johnson
Rebecca A. Krall
Florence Jinham Lui
Matthew D. Pocius
Gabriella Donna Shepard
Stephen Paul Sigda
Brian Patrick Tabata

Graduated August 2010
Christopher Steven Magnollay

Graduating August 2011
Mohit Raghunathan

Bachelor of Science in Physics with an additioal major in Philosophy
Jared Armand Delmar

Bachelor of Science in Physics with minors in Computer Science, Mathematical Science and Scientific Computing.
Maxwell Lipford Hutchinson

Bachelor of Science in Physics with a minor in Computer Science
Joshua Harvey Keller

Double Degree

Bachelor of Science Double Degree in Electrical and Computer Engineering and Physics with a Minor in Philosophy
Charles Francisco Delascasas

Bachelor of Science Double Degree in Mechanical Engineering and Physics, Applied Track
Andrew Harrison Kojzar
Justin M. Perry

Bachelor of Science Double Degree in Computer Science and Physics, Computational Physics Track
Robert Seon Wai Lee

Bachelor of Science Double Degree in Mechanical Engineering and Physics, Applied Track with a Minor in Philosophy
Sean Daniel Lubner

Bachelor of Science Double Degree in Material Science and Engineering and Physics
Anthony D. Rice

Bachelor of Science and Arts in Physics and Drama
Ariel Rachel Rosenburg

Bachelor of Science and Arts in Physics and Music
Peter Ross

Bachelor of Science and Arts in Physics
Andrew Jay Wesson

Minors in Physics
Jacualyn Carol Dudder
Noah Harp
Taylor Mead Hopper
Steven Si Lu
David James Marino
Anthony Maurice
Javier Novales
Frank Anthony Perry
Peter Sharp Ralli
Nicholas Daniel Sainz
Benjamin Beyer Segall
Michael John Sullivan
Joshua Adam Taylor
Peter Adam Trocha
Eric Lee Turner
Joshua Van Dyke Watzman

Undergraduate Honors

David A. Bemiller
University Honors

John J. Briguglio
University Honors

Charles F. Delascasas
University Honors
Phi Beta Kappa

Benjamin R. Ellison
University Honors
MCS College Honors
Phi Beta Kappa

Danielle M. Fisher
University Honors

Maxwell L. Hutchinson
University Honors
MCS College Honors
Phi Beta Kappa
Phi Kappa Phi

Andrew A. Johnson
MCS College Honors
Andrew Carnegie Society Scholar
Joshua H. Keller
University Honors

Andrew H. Kojzar
University Honors
CIT Research Honors

Rebecca A. Krall
University Honors
MCS College Honors
Phi Kappa Phi
Phi Beta Kappa

Robert S.W. Lee
MCS College Honors

Sean D. Lubner
University Honors
CIT Research Honors

Justin M. Perry
University Honors
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Anthony D. Rice
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Peter D. Ross
University Honors

Stephen P. Sigda
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MCS College Honors

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