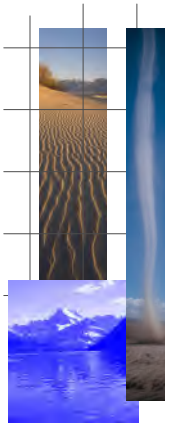

Schrödinger's Tiger

The Clemson University Physics and Astronomy Newsletter

Fall 2008 **Volume 3, Issue 1**

Our Department's Budget Challenges for the Coming Year

Dr. Peter A. Barnes, Chair

As Clemson's Department of Physics & Astronomy moves into a new academic year, both we and the University face a budget challenge of unprecedented scope. The State of South Carolina, like all sectors of our economy, has reeled under budget shortfalls and declining tax revenues. As a result, the University, and, consequently, the Department must make drastic cuts in our respective budgets.

In previous newsletters, we have outlined some of the funding needs for our department. Owing to reduced state support for Clemson, we are now facing the possibility of serious staff and resource cuts.

Until now we have been fortunate to have had a few dedicated donors to our department. The number, however, has been small relative to the staggering financial needs that we face. The University has asked the Department to cut its expenses by $90,000, which constitutes roughly our normal annual operating budget. We have tried to be judicious in our recommended budget cuts, while preserving the integrity and quality of our teaching programs. However, there are simply going to have to be reductions that will affect the Department and its ability to provide a quality education. To put the seriousness of this financial crisis into perspective, here are some examples of the tangible effects of cuts in our academic programs:

Atmospheric Physics Rocket Program. Two major campaigns are in progress; one in Norway (January 2009) and another in Alaska (February 2009). We can afford to send only two students to Norway and only one to Alaska. By comparison, in 2007 we were able to send twelve undergraduates to Alaska. The year before we sent three students to Japan and six to Kwajalein Atoll in the Pacific. The prospects now look grim for our ability to have students participate in future campaigns.

Astrophysics. Many students have an interest in visiting observatories at Kitt Peak (Arizona) and in Chile to take part in observational astronomy. Currently only students supported by research grants can participate in this research and for shorter periods of time.

Biophysics. This fledgling program has new young faculty requiring financial help to send students to conferences in the field. While the group has been generous in using its limited funds to support student conference attendance, reductions in funding are now constraining the ability to support student programs. Undergraduate research in biophysics will have to be curtailed.

(Continued on next page…)

Condensed Matter Physics. This, our largest research area, is better off by comparison to most, but generous support of both undergraduate and graduate student participation in national and international conferences will have to be cut back.

International Studies. The unique undergraduate program in surface physics at the Italian synchrotron in Bosavizza will probably be cancelled this year due to its high cost. This highly visible program, which has raised Clemson's image and reputation in Italy and Europe, will lose the ground gained after its introduction in 2005. Italian collaborators are interested in a joint Ph.D. program that will have to be postponed, or, perhaps, cancelled altogether.

Taking into account all these factors — the lack of financial support for staff to attend workshops and upgrade credentials and the lack of travel funds — you can see where the gains of the past ten years will be eroded in a very short period of time. We have included an envelope in this newsletter in the hope that you can contribute financial help to your department that is now facing this serious financial crisis. We would also like to receive your e-mail address, so that we can ensure that you continue to receive the newsletter, while saving mailing costs. We will continue to mail hard copies to those of you who prefer a physical copy.

As alumni of Physics & Astronomy, your contributions can make a lasting and tangible difference as we go forward. Any donation, no matter how large or small, is deeply appreciated and will go to serving the needs of our outstanding students and faculty.

Sincerely,

Peter A. Barnes, Professor and Chair
Department of Physics and Astronomy
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We Need Your E-Mail Addresses!

For future editions, we will be offering alumni the option of receiving *Schrödinger's Tiger* on-line in the form of a PDF file. This will save us considerable printing and mailing costs.

We ask that if you would like to receive an online copy in the future, please complete the form in the provided envelope and return it to the Department. We can continue to send a hard copy to those of you who would prefer one. Also please indicate if you would like to make a donation to Clemson Physics & Astronomy at this time. You may include a check with your returned information or make a secure online donation.

There are several ways to donate. If not using the enclosed envelope, you may send a personal check, made payable to Clemson University, to the following address: ***Clemson University, Physics & Astronomy Dept., 118 Kinard Laboratory, P.O. Box 340978, Clemson, SC 29634-0978; Attn: Rise Moroney****. Please specify in the memo section of the check whether you wish the donation to be made to the Physics and Astronomy General Fund or if you would like it put toward a specific project. Alternately, you may visit the Clemson website* ***http://www.clemson.edu/alumni/giving/ways/index.html*** *and make a secure electronic donation. Again, please specify that the donation go the Physics & Astronomy Department and indicate to which project you would like to donate. You may contact the Department directly at (864) 656-3416, should you have any questions regarding your donations. Thank you, as always, for your continued support of the Department!!!*

Dr. Apparao Rao Inducted as New Fellow of the American Physical Society

Dr. Apparao Rao was notified November 17, 2008 of his nomination for Fellowship in the American Physical Society (APS) upon the recommendation of its Division of Materials Physics. Election to the Fellowship in APS is limited to no more than one-half of one percent of its total membership. Moreover, election is a recognition by one's peers of the individual's outstanding contributions to the field of physics.

Dr. Rao's Fellowship citation, as well as those of others elected to the Fellowship in 2008, will be published in the March 2009 issue of *APS News*. It will also appear on the Fellowship Page of the APS Home Page (http://www.aps.org).

Dr. Apparao Rao at work in his lab

Presentation of Fellowship certificates is usually done at the annual meeting of the unit through which the Fellow was elected. Dr. Rao joins **Drs. Murray Daw, Brad Meyer, and Ray Turner** as professors from Clemson Physics & Astronomy previously elected as APS fellows.

After graduating with a B.S. degree in physics from the University of Bombay in 1983, Dr. Rao pursued his M.S. and Ph.D. degrees in condensed matter physics at the University of Kentucky, Lexington. He then worked as a Postdoctoral Associate in the departments of Physics and Materials Science and Engineering at the Massachusetts Institute of Technology before entering into academics. He moved to Clemson University in the fall of 2000, and his research focuses on the synthesis, properties and applications of nanostructured materials. Current projects involve the understanding of optical, electrical and mechanical properties of these materials. *(Please see the article on the following page for more information on Dr. Rao's work.)*

Plans Finalized to Establish Atmospheric Observing Station in Brazil

Clemson professor, **Dr. John Meriwether**, and his University of Illinois collaborator, **Dr. Jon Makela**, have finalized plans for shipping two Fabry-Perot interferometers to northern Brazil, to establish an observatory that will monitor atmospheric wave activity in a volume of the upper atmosphere from two different directions. The observations from each site will measure Doppler shifts and Doppler broadenings of the atmospheric emission of atomic oxygen at 630 nm. The combination of these results makes possible the determination of gravity wave fluctuations of wind and temperature within the region common to both directions.

Also included in this project will be all-sky imaging observations of the 630-nm emission range. The purpose of these measurements is to study how gravity wave activity might influence the development of plasma depletions within the equatorial ionosphere, which impacts the quality of radio wave communications. Two trailers with the instrumentation will be shipped in the near future, and Dr. Meriwether and **Greg Twork, a** Physics Department student, travelled to Brazil during the Christmas holidays to help set up the observatories for this research.

Clemson Scientists Put a (Nano) Spring in their Step

Each year you can buy electronic devices that are smaller and more complex than ever. But don't drop your cell phone too many times—it turns out that fragility is the price for miniaturization. Clemson University researchers, however, may have something to say about that if they have their way. A team led by **Dr. Apparao Rao**, has invented a way to make beds of tiny, shock-absorbing carbon springs that can be used to protect delicate objects from impacts. Along with collaborators at the University of California at San Diego, Rao has shown that layers of these tiny springs, each a thousand times smaller than a human hair and termed *coiled carbon nanotubes*, can act as extremely resilient shock absorbers. And contrary to shrinking electronics, it turns out that miniaturized carbon springs lose none of their durability as they become smaller.

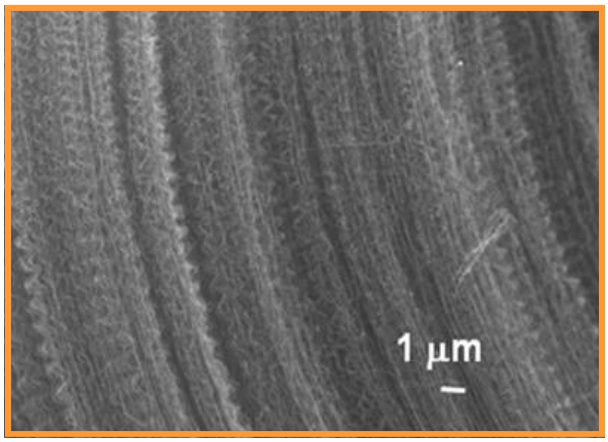


Fig. a

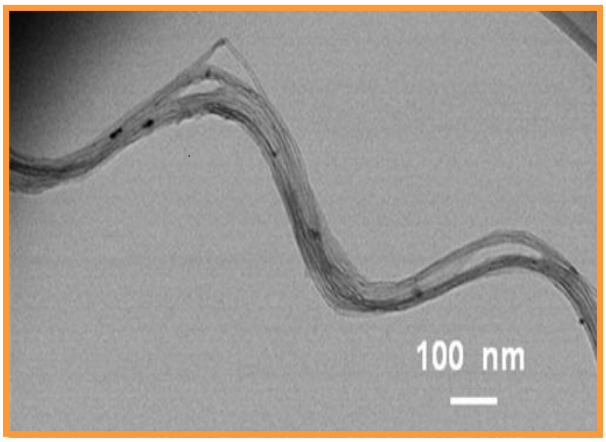


Fig. b

Figure (a) in the left panel is an image of a bed of coiled nanotubes and Figure (b) on the right is a magnified image of a few strands extracted from this bed. The corresponding scalebars are in the units of 1 micrometer (a millionth of a meter) and a nanometer (a billionth of a meter).

While other scientists have made similar coiled carbon nanotubes before, Rao's method is unique since beds of coiled carbon nanotubes can be grown in a single step using hydrocarbons and are a proprietary catalyst mixture. "The problem we have faced in the past is producing enough of these coiled carbon nanotubes at a reasonable enough cost to make a difference," said Rao. "Because our current method produces coiled nanotubes quickly in a high yield, it can be readily scaled up to industrial levels. After formation, the coiled nanotubes can be peeled off in one piece and placed on other surfaces to form instant cushioning coatings."

In earlier studies Rao and his team, along with UCSD collaborators, impact-tested more conventional straight carbon nanotubes against coil-shaped nanotubes. When a stainless steel ball was dropped onto a single nanotube layer, the coiled nanotubes completely recovered from the impact, while the straight ones did not. "It's like an egg toss," said Rao. "If you move your hand backward as you catch the raw egg and increase the time over which the impact occurs, the impact force will be less forceful and the egg will not break. It is the same phenomenon experienced by a catching a baseball."

While the coiled nanotubes are very small, Rao's group is thinking big when it comes to other uses for their technology. "There is no reason why we should not be able to protect current products from damage due to accidental impacts" said Rao. "We envision coiled nanotubes in soldiers' body armor, car bumpers and bushings, and even as cushioning elements in shoe soles."

(Continued on next page…)

In previous research the group developed a process by which a traditionally straight carbon nanotube can be coaxed to split into a "Y" shape. When appropriately powered by electrical voltages, the Y-branched nanotubes behave like tiny switches or transistors that process information. "Our studies with carbon nanotubes have been an ongoing process for quite some time," said Rao. "Each step along the way has led to the next breakthrough, and each time we've learned more about how they grow and what their applications could be. We believe that carbon nanotubes have tremendous potential in the lives of each one of us."

Clemson Professor Advises on Experiments at Japanese Laboratory

About one-half of isotopes in nature that are heavier than iron were produced in the rapid neutron-capture process (the "r process") in exploding stars. Among these isotopes are the precious metals, such as silver, gold, and platinum. Interestingly those isotopes were not made as themselves, but rather as extremely neutron-rich, short-lived progenitors that subsequently decayed into their current form. The parent progenitors require such extreme conditions of neutron density that they cannot exist in abundance in laboratories on Earth. That is, until now.

Drs. Nagai, Kajano & Meyer (left to right) at Shinto shrine near Yamagata University, where conference was held.

Accelerators at laboratories in the U.S., Germany, Canada, and Japan now can produce the neutron-rich progenitors of the r-process isotopes in sufficient quantities that they may be studied experimentally.

Among these facilities, the accelerator at RIKEN, the large natural sciences laboratory in Wako, near Tokyo, Japan is currently one of the most productive in studies of neutron-rich isotopes. The experimental studies being carried out at RIKEN and elsewhere are yielding great insight into the force that holds nuclei together and providing crucial input into theoretical studies of r-process nucleosynthesis.

As these experimental studies expand, there is a need for an accompanying theoretical framework to study the implications of the experiments and theoretical guidance on new experiments to be conducted. For this reason, RIKEN scientists convened a workshop in Wako-shi on the "New Era of Nuclear Physics in the Cosmos–the r-process nucleosynthesis" from September 23 to 25, 2008. **Dr. Brad Meyer** was invited as the sole non-Japanese participant. He presented a talk and advised colleagues on experiments of astrophysical interest. He also installed *libnucnet*, his open-source toolkit for storing and managing nuclear reaction networks (see http://www.webnucleo.org/home/modules/libnucnet) on RIKEN computers. He and RIKEN scientists will use libnucnet-based computer codes to collaborate on implications of RIKEN experiments for r-process nucleosynthesis.

During his visit to Japan, Dr. Meyer also gave talks at the National Astronomical Observatory in Mitaka, at the Japan Physical Society Meeting in Yamagata, and at Konan University in Kobe. The trip was funded by the Japan-U.S. Theory Institute for Physics with Exotic Nuclei (JUSTIPEN), whose purpose is to deliver an international venue for research on the physics of nuclei during an era of experimental investigations on rare isotopes.

Understanding the Fate of Nanoparticles in Living Systems

Engineered particles have increasingly been used for detection and medical purposes, or discharged into the environment through laboratory and industrial outlets, or via the pathways of air, water, and soil. The physical properties of engineered nanoparticles are complex, and are distinctly different from their bulk counterparts that are conventionally described by condensed matter physics or polymer science. When interacting with living systems, nanoparticles may be functionalized by free radicals, surfactants, and biomolecules to elicit biocompatibility. Furthermore, the transformation and transport of nanoparticles, especially in the liquid phase, present tremendous challenges for detecting and predicting their fate in living systems.

A major research effort in the lab of Clemson professor **Dr. Pu-Chun Ke**, supported primarily by the National Science Foundation, has been focused on understanding the fate of nanomaterials in biological systems or those discharged into the environment. Engineered particles that have been studied include fullerenes, quantum dots, as well as microplastic particles. These particles have been accumulating in the great Pacific basin, an area twice the size of Texas. Below are two highlights of the research.

The physical interaction between nanoparticles, mostly hydrophobic in the aqueous phase, often causes their aggregation. When introduced to a mammalian cell, nanoparticles can be adsorbed on the cell membrane owing to their high mutual binding affinity. Over time this adsorption escalates to exert a physical pressure on the membrane. As a result of the altered osmotic pressure across the membrane, lipid diffusion may be hindered to modify the cell morphology (Figure 1). This discovery, published recently in the high-impact journal of *Small*, was a collaborative work between the Ke lab, a Finnish group at Helsinki University of Technology, and the Rao lab in Physics and Astronomy.

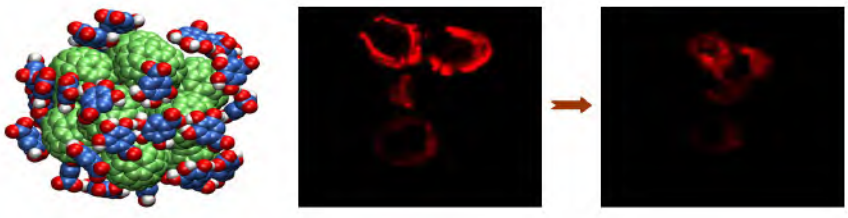


Figure 1. (Left) Molecular dynamics simulation of fullerene C_{70} molecules (green) coated by gallic acid (blue-red). (Middle-Right) Cell contraction induced by the adsorption of C_{70} coated with gallic acid. The cell membranes were labeled with lipophilic dye, displaying as red rings on confocal microscopy.

The Ke lab, together with the Rao lab in Physics and Astronomy and the Luo lab in Genetics and Biochemistry, have recently performed some of the earliest and most extensive studies on the transport of nanoparticles in high plants, the primary link in the food chain. In this study, fullerene particles were first suspended in natural organic matter through self assembly, and then were exposed to rice seeds prior to germination. After two weeks of incubation, the researchers found the presence of the fullerene aggregates in the vascular systems of the roots, stems, leaves, and harvested seeds of the first-generation plants, suggesting that they shared the same pathway with water and nutrients for the uptake and transport in the organism. As the first evidence of multigenerational transfer, the researchers discovered the presence of fullerene in the second-generation plants, geminated from the seeds of the first-generation rice. These findings have tremendous implications for future research.

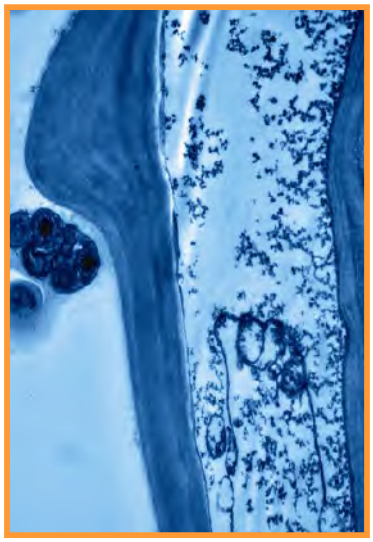


Figure 2. (at right) Transmission electron microscopy image of numerous C_{70} particles in the leaf cell of a rice plant.

Clemson's Astronomy Partnership with South Carolina State University

Students Eric Bubar (left) and Jared Lalmansingh in the control room of the 4-meter (the mirror's diameter) telescope at Kitt Peak National Observatory in Arizona.

Students Eric Bubar and Jared Lalmansingh with the Echelle spectrograph at the Cassegrain focus of the 4-meter (the mirror's diameter) telescope at Kitt Peak National Observatory in Arizona.

Clemson astronomers began to work with physics and astronomy colleagues at South Carolina State University (SCSU) in 2008 to build collaborative research opportunities and to prepare their students for graduate studies in astrophysics at Clemson. The National Optical Astronomy Observatories (NOAO), in Tucson Arizona, is also a partner in this National Science Foundation-funded, five-year initiative.

Students in the new astronomy option in the SCSU Department of Biological and Physical Science will receive scholarships to enable them to study astronomy during the academic year, learn astronomical techniques and to engage in research each summer. The program supports release time from heavy course loads for SCSU faculty, in order to be better able to mentor students and develop their own research. In their second or third summer, these students can work with any of Clemson's five research astronomers on projects in ground- or spaced-based observations, or in theoretical studies of a number of different astrophysical problems. When the students enroll in graduate studies at Clemson, they will receive fellowships to relieve them of some teaching duties and to enable them to mentor other students following the same path.

Three SCSU students and two professors visited Clemson in July 2008 to discuss their summer's work, hear about research opportunities from graduate students and faculty, get to know Clemson, and hear straight from students what graduate school is like. **Dr. Mark Leising** visited SCSU in September to meet faculty and students, and to give the students details on problems and opportunities in high-energy space astronomy. **Professor Don Walter**, the principal investigator of the project, and SCSU sophomore **Jared Lalmansingh** accompanied Clemson Ph.D. student **Eric Bubar** on an observing run on the Mayall 4-meter telescope at Kitt Peak National Observatory near Tucson in November to measure elemental abundances in nearby stars.

It is expected that the more advanced among the SCSU students will visit Clemson this spring to develop research plans for summer 2009. They will be able to choose among projects involving young stars, gamma-ray bursts, nuclear reactions in stars, antimatter in the central Milky Way, and the evolution of abundances in stellar surfaces.

Imperial College Professor, Antony Valentini, Invited to Clemson as Sobczyk Lecturer

This year's Sobczyk Lecturer was the distinguished **Dr. Antony Valentini**, whose well-received talk was titled "Quantum Mechanics and Reality: the Schism in Physics". The lecture was widely advertised to the general Clemson community and had more than 300 attendees, including local high school students.

Valentini discussed in layman's terms the foundations of quantum mechanics, especially the divergent opinions of two camps that emerged during the seminal years of quantum theory development. One camp, led by **Bohr** and **Heisenberg** and others, contended that new discoveries of quantum mechanics proved that the world is not real, but rather exists in an indeterminate state. The other camp, led by **deBroglie**, **Einstein** and others, posited the opposite --- that there is an objective reality, and that to argue otherwise is logically inconsistent. Dr. Valentini guided the audience through a recounting of that debate that culminated at the historic 1927 Solvay Conference. Those events are described and analyzed in a new book, co-authored by Valentini, titled "Quantum Theory at the Crossroads: Reconsidering the 1927 Solvay Conference". Especially enlightening is Valentini's re-evaluation of the role of Louis deBroglie, whose theories --- though discounted somewhat in the intervening years --- have actually proven to be viable alternatives to the now -disputed "Copenhagen Interpretation".

Dr. Valentini, from the Imperial College in London, visited Clemson for a week, and was very generous with his time and energy. In addition to the public Sobczyk Lecture, he presented two student tutorials on the subject of pilot-wave dynamics, and a joint math/physics/astronomy colloquium on possible quantum remnant signatures of the Big Bang.

The Sobczyk Lecture Series brings to Clemson some of the world's leading physicists and mathematicians. It is supported by an endowment that the Sobczyk family established in memory of Dr. Andrew Sobczyk, the Samuel Manor Martin Professor of Mathematics at Clemson until his death in 1981. This year's is the 27th year of the series, which is shared by the departments of Mathematical Sciences and Physics and Astronomy.

Dr. Antony Valentini of the Imperial College of London

Clemson Lecturer Participates in Valuable SC CAP Program

Dr. Amy Pope is a senior lecturer in the department, and she engages students through the use of demonstrations and student-led, problem-solving situations. Her Physics I course has been deemed by the Center for Educational Policy Research as a "best practice course", with certain elements considered to be exemplary.

Dr. Pope was selected to be a member of the South Carolina Course Alignment Program (SC CAP) design team. The design team is composed of faculty from secondary and post-secondary schools throughout the State. The faculty members work together in teams to align educational expectations between secondary and post-secondary schools in South Carolina in the areas of English, mathematics, chemistry, biology and physics.

The SC CAP has been needed for many years. The collaboration between secondary and post -secondary schools is allowing the team to take a critical look at the expectations universities place on students. With college expectations in view, paired courses are designed to better prepare students, while still in high school, for the more rigorous college education they will receive. This project has the potential to heighten student retention and performance at the college level.

Clemson Alum, Jack Deslippe, Returns to Give Department Colloquium

Clemson alumnus **Jack Deslippe** (B.S. Physics, 2004) visited the campus this fall and was invited to present the department colloquium, titled "Calculating Measurable Quantities of the Ground-State, Excited-State and Golden State: Or What I Have Done Since Leaving Clemson".

Deslippe is in his fifth year of graduate studies at the University of California at Berkeley. In his colloquium he discussed details of his thesis research into electronic states of graphene and carbon nanotubes. While at Clemson Jack worked primarily with **Dr. Murray Daw**, whose research area comprises theoretical condensed matter physics. Additionally, Dr. Daw is a Fellow of the American Physical Society (APS).

Jack Deslippe (right) works a problem with Dr. Murray Daw, while a Clemson student.

Adria Updike Sets Her Sights on Gamma Ray Bursts

Adria Updike at observatory in La Silla, Chile

Clemson Ph.D. student **Adria Updike** traveled to La Silla Chile in June 2008 to begin training on the operation of the GROND instrument, built and maintained by the Max Planck Institute for Extra-terrestrial Physics in Garching, Germany. She returned in November to support a month-long observing run for the Clemson-MPE collaborative effort to find the earliest exploding stars in the Universe.

Gamma Ray Bursts (GRBs) are high-energy transients, lasting only seconds to minutes. They are thought to accompany black hole formation during the collapse of a massive star. They are so bright that we can easily detect them (with satellites) across the Universe. They are often followed by an "optical" afterglow, visible from radio to x-ray bands for hours, days, or weeks, depending on distance and the sensitivity of the telescope employed. Afterglows can be used to find and probe the first galaxies. The Swift satellite detects and localizes about two GRBs per week, immediately sending positional information to ground-based observers.

The GROND instrument is mounted on the 2.2m telescope at the European Southern Observatory at La Silla, Chile. It takes simultaneous images in the optical and near-infrared bands, which allows for rapid photometric determinations of GRB distances (redshifts). A 'band dropout' occurs in the ultraviolet part of the spectrum as a result of the absorption of intervening neutral hydrogen. For bursts at higher and higher redshifts, the dropout is shifted into the visible part of the spectrum, resulting in a detection in the redder bands but not the bluer bands. The specifics of this dropout provide quick indicators of GRB redshift. High redshift bursts are of particular interest to cosmologists working on the changing composition of the Universe, and GROND is able to trigger observations on larger telescopes based on the rapid redshift estimate. GROND detected the most distant burst to date, GRB 080913 at a redshift of 6.7, which happened 12.8 billion years ago!

Grad Student to work at NIST Next Semester

Russell Lake, a third-year graduate student working with **Dr. Chad Sosolik**, is getting a unique chance to work at the National Institute of Standards and Technology (NIST) in Gaithersburg, Maryland over the next semester. As part of a collaborative project with **Dr. Joshua Pomeroy** of the Quantum Processes and Metrology Group in the NIST Atomic Physics Division, Russell is fabricating magnetic tunnel junction devices for use within the NIST Electron Beam Ion Trap (EBIT) Facility. Using the EBIT, Russell will expose his fabricated devices to focused beams of highly charged ions, such as Xe^{44+}. These ions are known to transfer large amounts of energy into a multilayered device upon impact at the surface. Russell will probe the transport properties of his devices following ion exposures and use that information as a unique way to explore the role of kinetic and potential energy effects in ion-surface interactions. This project is jointly funded by the NSF, NASA, and NIST. Further information on the NIST EBIT facility can be found here: http://physics.nist.gov/MajResFac/EBIT/ebit.html.

Russell Lake will work at NIST Spring of 2009.

Clemson Students Attend Nobel Laureates' Talk & Conference in Lindau Germany

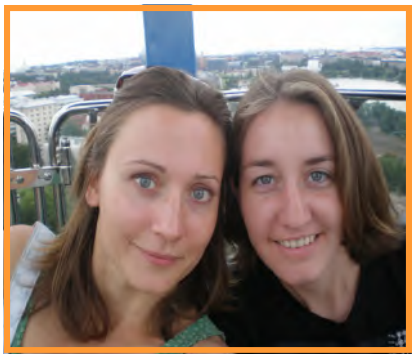
Sixty outstanding graduate research students attended the 58th Annual Lindau Meeting of Nobel Laureates and Students in Lindau, Germany, from June 29 through July 4, 2008. The event featured lectures and discussions on physics. Included in this group were two Clemson students, **Jason Reppert** and **Russell Lake**. The 60 students were sponsored by the U.S. Department of Energy (DOE), the National Science Foundation (NSF), Mars, Inc., and Oak Ridge Associated Universities (ORAU).

Continuing a tradition established in 1951 by the late **Count Lennart Bernadotte**, Nobel Laureates in chemistry, physics or medicine/physiology convene annually in Lindau to conduct open and informal meetings with more than 500 graduate students and junior researchers from around the world. Lindau is also the location for an annual meeting in economic sciences. The third of such gatherings, which involved fourteen Laureates in economic sciences, Nobel Peace Prize winner **Muhammad Yunus** and more than 300 of the world's best young economists, took place August 20–23.

During this year's meeting, the Laureates lectured in the mornings on the topics of their choice related to physics and later participated in less-formal, small-group discussions with the students in the afternoons and some evenings. The primary purpose of the meeting is to allow participants—most of whom are students—to benefit from informal interaction with the Nobel Prize winners. During lunches and dinners, Laureates joined participants at local restaurants for informal discussions. Various social events also allowed participants to meet other attendees from around the world. In addition, the participants were able to experience the picturesque island city of Lindau, which is located at the eastern end of Lake Constance, just north of the Swiss Alps. Situated at the common border of Austria, Germany and Switzerland, Lindau is a city with a rich medieval history and has, historically, been a focus of Central European culture.

The Oak Ridge Institute for Science and Education (ORISE) is a U.S. Department of Energy institute focusing on scientific initiatives to research health risks from occupational hazards, assess environmental cleanup, respond to radiation medical emergencies, support national security and emergency preparedness, and educate the next generation of scientists. ORISE is managed by Oak Ridge Associated Universities.

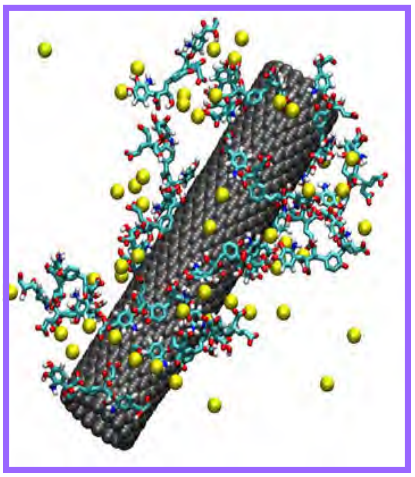
Expanding their Horizons



Tatsiana Ratnikova, (left), & Michelle Reid in Finland summer of 2008

Two of **Dr. Pu-Chun Ke's** students, **Michelle Reid** and **Tatsiana Ratnikova,** conducted their summer research at Helsinki University of Technology in Finland from June 4 to Aug 10, 2008. This research was sponsored by Dr. Ke's NSF-IREE grant and NSF Career Award. Michelle Reid is a senior, double majoring in Physics and Electrical and Computer Engineering. Her trip was paid by the NSF -IREE grant. Tatsiana Ratnikova is a Ph.D. student in Physics, and Dr. Ke's NSF Career Award helped to pay her travel.

While in Finland, Michelle and Tatsiana used atomistic and coarse-grained molecular dynamics techniques to simulate how carbon nanoparticles, when discharged into the environment, may interact with natural organic matter, the substance abundant in all river sources and agricultural soils. At left is a snapshot of their simulations showing the binding of TNB molecules (major components of natural organic matter, shown in cyan and red) onto a single-walled carbon nanotube (gray). The golden balls represent sodium ions for neutralizing the net charge of the simulation system. A manuscript based on this research was submitted in December. As an IREE trainee, Michelle will be presenting her research at the National Science Foundation on February 2-3, 2009.



Simulation of TNB molecule binding

Tianhong Yu

Tianhong Yu Attended Summer School on Exotic Beam Physics

Clemson University physics student **Tianhong Yu** was one of 55 graduate students selected from around the world to participate in the 7th Summer School on Exotic Beam Physics held August 4-10, 2008 at Argonne National Laboratory in Chicago. The School's purpose is to nurture future scientists for the Facility for Rare Isotope Beams (FRIB), the next-generation, U.S.-based radioactive beam facility that will study nuclei far from stability. FRIB will be the U.S. equivalent of other radioactive beam facilities, such as RIKEN in Japan. (See article on page 5).

With this next-generation facility, scientists will be able to probe nuclei at the very limits of existence. These studies will enable us to improve our predictive power of nuclear properties for all nuclei, and understand the processes which lead to the synthesis of the elements around us. New technologies will be needed both for producing exotic nuclear beams and for studying them.

School participants listened to lectures on theoretical and experimental nuclear physics in the mornings and then performed "hands-on" studies with the radioactive beams from the ATLAS accelerator at Argonne. Tianhong also presented his research in statistical mechanics related to nuclear physics.

Department News

***Amanda Crumpton**, one of our valuable administrative assistants, and her husband Ben, are expecting a new baby girl, due on March 17, 2009. The Crumptons have two other children, Peyton, age 7, and Ava born in 2007. Congratulations to the Crumptons on the new addition to their family!*

*The Department would like to extend its condolences to **Dr. Ray Turner** on the loss of his mother, Mrs. Fannie Turner, age 92, on October 25, 2008 in Pittsburgh, Pennsylvania. Mrs. Turner was the wife of the late Clyde A. Turner, and is survived by three sons and a daughter, and five grandchildren. Dr. Turner is an Alumni Distinguished Professor Emeritus of Physics and has taught in the Physics Department since 1968.*

*Happy Belated Birthday to **Dr. Emil Alexov** and **Rise Moroney**, our office manager. Both have reached their 50th, but don't look a day over thirty!*

If you have any suggestions for the newsletter, or any other constructive input on its format, please email your thoughts to: rvogt@clemson.edu. To subscribe or unsubscribe to *Schrödinger's Tiger*, please go to our mail list at: **http://www.ces.clemson.edu/mailman/listinfo/panda-newsletter.**

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