Cardiologist Waenard L. Miller and his wife, Sheila, of Frisco, Texas, have given $2 million to Clemson University to establish the Dr. Waenard L. Miller, Jr. ’69 and Sheila M. Miller Endowed Chair in Medical Physics.

“My vision of the medical physics program is a multidisciplinary collaborative endeavor associated with excellence in research, exponential growth in innovation, and outstanding educational opportunities for students,” Miller said.

Miller earned his physics degree from Clemson in 1969. He received his medical degree from the Medical University of South Carolina and completed his internal medicine residency and a fellowship in cardiology at the University of Texas Southwestern Medical School. He also holds master’s degrees in nuclear physics, biology and medical management.

“My career started with my experience in physics at Clemson, with the faculty there, who instilled in me an excitement for learning about the wonders of the physical world,” Miller said. “I was like a sponge. I absorbed it all and was just fascinated by physics. That desire for continual learning and inquiry has lasted throughout my entire career.”

The Millers met when they were in high school in Greenville. Sheila’s father, Bernyrd C. McLawhorn, was a Greenville physician with a degree in physics from Furman and a medical degree from Duke. McLawhorn encouraged and mentored Waenard in his medical career. “We had a common language in physics, but I was equally inspired by his knowledge of medicine and his commitment to his patients,” Miller said. “My father-in-law was clearly the role model for my eventual choice of medicine as my vocation.”

Sheila fondly remembers the friendship between her father and her future husband. “When I was dating Waenard, I knew I had to get to the door immediately, because if I didn’t get there right away the two of them would go off in a corner and start talking about black holes, and we’d be late for wherever we were going,” she said. Miller was in the Air Force Reserve Officers’ Training Corps at Clemson and was commissioned as a
A Message from the Department Chair

It has been a very active spring semester for our department. It is hard to believe that I have been in this position just over five months. I have now held every academic position in the department — from being an undergraduate to being the chair. We had a very successful graduate recruiting season, with thirteen new teaching assistants scheduled for the fall. Moreover, several of our top-rated applicants accepted our offers. We are looking forward to their arrival in August. In addition, we are on par with our undergraduate recruiting. At this point we are expecting a class of twenty or more for the freshman class in the fall. Many of our current undergraduates were honored with awards, about which you can read more in this newsletter. Go PandA!!

In this newsletter you will read about the endowed chair in medical physics that was announced on May 5, 2016. This is an exciting development for our department. The department had a very successful search for a new atmospheric physics faculty member this spring, and Dr. Xian Lu will be joining the faculty in August. Dr. Jens Oberheide was promoted to full professor this spring, as well. Dr. Feng Ding (biophysics) was awarded an NSF Career Award, and we are very happy that all of Dr. Ding's hard work has paid off. The astrophysics group is very excited about the announcement of the discovery of gravitational waves, related closely to the work of Dr. Dieter Hartmann and Dr. Marco Ajello.

One of the very exciting events happening on July 1, 2016 will be the formation of the new College of Science (COS) at the University. This college will consist of biological sciences, chemistry, genetics and biochemistry, mathematical sciences, and physics and astronomy. Our very own Dr. Mark Leising is serving as the founding Interim Dean of this new college. We all look forward to the challenges and the opportunities that this coming year will bring to our department and the new college.

Dr. Terry Tritt, Interim Chair
Voice: (864) 656-3416
email: ttritt@clemson.edu

Creating a Legacy — Giving to Clemson Physics & Astronomy

You can create a lasting legacy through your donation to the Clemson University Physics and Astronomy Department Foundation. Endowments to Clemson assure the best faculty, the brightest students and the most creative research projects. A substantial endowment can transform a good university into a great one. As a non-profit organization, the Foundation is exempt from federal income tax under Section 501(c)(3) of the 1986 Internal Revenue Code, as amended. The Foundation has been classified by the IRS as a public charity operated for the benefit of a state university as defined in the Internal Revenue Code of 1986 Section 170(b)(1)(A)(iv). Contributions to the University through the Foundation by individuals, corporations, organizations and other foundations qualify as tax deductions.

There are several ways to donate. You may send a check to the Clemson University Foundation, P.O. Box 1889, Clemson, SC 29633. Checks should be made payable to the Clemson University Foundation with Physics and Astronomy specified on the memo line. Alternately, you may visit the Clemson website: http://www.clemson.edu/giving/how/ 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.

Thank you, as always, for your continued support of the Department. You may contact the Annual Giving Office at (864) 656-5896, should you have any questions regarding your donations. If you have other questions you may contact the Department directly at (864) 656-3416.
second lieutenant upon graduation. The Air Force sent him to graduate school at the University of Tennessee in nuclear physics, and then stationed him at Wright-Patterson Air Force Base in Ohio, assigning him to the foreign technology division as a physicist. He later transferred to the Aerospace Medical Research Laboratory, and there became intrigued with the combined concept of physics and biology.

Miller co-founded the Legacy Heart Center in Dallas in 1995. Under his leadership, LHC became renowned for leading-edge cardiovascular care. Texas Monthly magazine named him a “Texas Super Doctor” for eight consecutive years – a designation determined by a poll of doctors and nurses across the state of Texas, as well as through independent research.

Clemson University President James P. Clements described Miller as one of the university’s most accomplished alumni, and thanked him and his wife for being so engaged and generous. “Waenard and Sheila already have established a significant legacy. We are so honored that they have decided to partner with Clemson to enhance their legacy even further,” Clements said.

“This wonderful gift will allow us to expand our internationally acclaimed biomedical research program and help meet the demand for medical physicists in the health care industry.”

The endowed position will be a joint appointment in Clemson’s departments of physics and astronomy and bioengineering. While collaborating with medical partners of Clemson University, the research conducted by the endowed chair holder will be at the interface of science and engineering with clinical translation as the outcome.

Mark Leising, former chair of Clemson’s physics and astronomy department and interim dean of the new College of Science, said the endowment will most certainly achieve the Millers’ goals and more.

“Dr. and Mrs. Miller’s gift will invigorate our medical physics education and research programs,” Leising said. “Bringing more physicists and physical science techniques to medicine will continue to improve patient care and fill an important need of our state.”

Martine LaBerge, chair of Clemson’s bioengineering department, noted that Miller has spent his career on the cutting edge of medicine, raising the level of care higher and higher for patients, and the endowment will ensure that future generations of Clemson graduates can do the same.

“Medical physics research is at the forefront of patient care,” said LaBerge. “With this generous gift, Clemson University will continue to lead the field of medical diagnostics and will make a significant impact in basic and applied research to improve patient outcomes.”

The Millers’ gift is a part of Clemson University’s $1 billion “The Will to Lead” capital campaign to support faculty and students with scholarships, professorships, facilities and technology.

Clemson Media Release by Ken Scar, May 5, 2016
Mathematical Biosciences Institute Emphasis Semester Co-organized by Clemson Biophysicist Emil Alexov

In the fall of 2015 the Mathematical Bioscience Institute (MBI) at Ohio State University hosted an emphasis semester organized by Guowei Wei (Michigan State University), Ridgway Scott (University of Chicago), Reidun Twarock (University of York) and Emil Alexov (Clemson University). The goal of the program was to bring together researchers from mathematics, chemistry, physics, biology, computer science, and engineering to explore new ways to bridge these diverse disciplines and to facilitate the use of mathematics to solve open problems at the forefront of the molecular biosciences. The topics comprised geometric and topological modeling of biomolecules, multiple faces of biomolecular electrostatics, modeling and computation of transmembrane transport, and mathematical challenges in drug and protein design.

The motivation for organizing such an emphasis semester stems from the trends observed nowadays in many scientific disciplines. Thus, with availability of modern biotechnologies and DNA sequencing techniques, traditional disciplines, such as physiology, plant biology, neuroscience and many others, are undergoing a fundamental transition from macroscopic phenomenological ones to molecular-based biosciences. Experimental exploration of molecular biological systems (such as HIV viruses), molecular motors and proteins in various diseases, are examples of driving forces in scientific discovery and innovation in the past few decades.

Clemson biophysicist Dr. Lin Li presented an investigation on the role of electrostatics in the complex phenomena of cargo transport in the cell.

Clemson University was represented in another two talks given by Dr. Emil Alexov. Alexov elaborated on the role of membrane environment in understanding molecular mechanism of various human diseases. The second talk addressed targeting disease-causing mutations with small molecules, potential drugs. This requires developing computational tools for modeling effects of human DNA variants on the structure, function and interactions of the corresponding macromolecules.

Dale Hitchcock (Clemson B.S 2009, Ph.D. 2014, currently a staff scientist at Savannah River National Lab, Department of Energy) and current student Andrew Shore (sophomore) conducted inelastic neutron scattering experiments at the Spallation Neutron Source (SNS), Oak Ridge National Lab, Department of Energy, from March 14th to 18th of this year. The SNS is a 1.3 billion dollar user facility, the most powerful neutron scattering facility in the world.

The purpose of this three-day beam line experiment was to probe the intriguing lattice dynamics (phonon density of states, Boson peaks, and anharmonicity) of the Argyrodite Ag8GeTe6. Ag8GeTe6 is a rare material in which fast ionic conduction coexists with promising thermoelectric performance.
Emily Thompson Pursues Path in Particle Physics

Emily Thompson will graduate in May as one of Clemson’s most decorated physics undergraduates, racking up honors from a Goldwater Fellowship to an Astronaut Scholarship and “every award available to her at Clemson,” according to Mark Leising, the interim dean of the new College of Science.

In April, Emily turned down a highly coveted, highly competitive National Science Foundation Graduate Research Fellowship and acceptance into the University of California at Berkeley’s doctoral physics program. Instead, she accepted a German Academic Exchange Service award and chose to matriculate at the University of Bonn in Germany. Bonn is a train ride away from the European Council for Nuclear Research, a.k.a. CERN, home of the modestly named Large Hadron Collider, the world’s largest particle accelerator. In 2015, Emily was one of fifteen American college students who interned at the pantheon of particle physics.

Clemson’s physics undergraduate program is renown. The students regularly win awards and national scholarships, said Jens Oberheide, a professor in physics and astronomy who shepherds students in the College of Engineering and Science through the awards and scholarships process.

“A good number of students are truly excellent and move on to top-tier physics Ph.D. programs,” Oberheide said. “In my six years at Clemson I would put Emily at the top...Emily is rational enough, but also daring enough to turn down an NSF graduate fellowship and an offer from U.C. Berkley,” he said. “This is something we teachers should be, and are, proud of.” Emily credits professors like Oberheide with her undergraduate success.

Emily notes that her academic adviser, Catalina Marinescu, a professor in the department, “really stepped in to help with the grad school application process. She made me apply to really hard schools, like ETH Zürich, and really got me out of my comfort zone.” When Emily decided she wanted to study particle physics (a program that Clemson doesn’t offer), her professors stepped in and found opportunities for her to get that experience at other schools during the summers.

While at Clemson, Emily has worked hard to teach girls and women about science so they might not face the same fears about physics she had and to increase the number of women joining the STEM fields. All female freshmen at Clemson who major in science or engineering are assigned a female mentor in the same field.

In her senior year, Emily mentored more than twenty students. Through the Women in Science and Engineering (WISE) program, she learned more about a career as a physicist from other students and faculty. She passed that knowledge along when she led physics experiments for middle school girls as part of a WISE outreach program. Getting more women into science is one of Emily’s long-term goals. Another: discover the secrets of the universe.

Adapted from Media Relations article by Clinton Colmenares, May 2, 2016
From left to right: the department award winners are Girish Sharma, Gary Vestal, Jaclyn Schmitt, Joshua Hanson, and Amber Porter.

**Physics and Astronomy Students Honored for Academic Success**

This year’s department physics and astronomy student awards ceremony was held on April 1st in Kinard Hall.

Also in April the College of Engineering and Science honored exceptional students from its departments at the annual Honors and Awards ceremony in the Madren Conference Center ballroom.

Several physics and astronomy students garnered honors and recognition again.

In addition to department and college-level awards, the Society of Physics Students gave its SPS Senior Award to Emily Thompson.

### Department Awards

- **Girish Sharma**: Outstanding Graduate Research Assistant
- **Gary Vestal**: L.D. Huff Junior Award
- **Jaclyn Schmitt**: Samantha Cawthorne 2010 Award
- **Joshua Hanson**: L.D. Huff Sophomore Award
- **Amber Porter**: Outstanding Graduate Teaching Assistant

### Physics Students Who Garnered College of Engineering and Science Awards

- **Girish Sharma**: Graduate Researcher of the Year
- **Dhruva Kulkarni**: Graduate Teaching Assistant of the Year
- **Emily Thompson**: Outstanding Senior Award
- **Gary Vestal**: Outstanding Junior Award

Congratulations to all these super students!

At right: This year’s COES’ awardees include (from left to right) Girish Sharma (physics & astronomy), Dhruva Kulkarni (physics & astronomy), Sarah Stafford (bioengineering), Elizabeth Zanin (biosystems engineering), Sarah Donaher (environmental engineering), Cassidy Laird (biosystems engineering), Gary Vestal (physics & astronomy) and Xinyu Lu (mechanical engineering).
Clemson Receives 100,000 Strong in the Americas
Grant to Support Study-abroad

Clemson University is among nine universities receiving new 100,000 Strong in the Americas Innovation Fund grants to support university partnerships and new study-abroad programs.

The grants, sponsored by ExxonMobil, were announced by the White House, U.S. Department of State, Partners of the Americas, and NAFSA: Association of International Educators at an event with Vice President Joe Biden.

“We have to invest in the greatest natural resource we all have – in our people. This investment in our young minds is critically important,” Biden said. “It rests on exposure: exposure to culture, language and politics of other countries. That’s how we’re going to build the closest ties that will cement the economic growth and stability of this hemisphere.”

The goal of 100,000 Strong in the Americas, President Obama’s signature education initiative in the Western Hemisphere, is to increase the number of U.S. students studying in the Western Hemisphere to 100,000, and the number of Western Hemisphere students studying in the United States to 100,000 by the year 2020. Clemson is partnering with Tecnológico de Monterrey, Monterrey, México, in a project titled “Promoting Cross-Cultural Physics and Engineering Teams for Today’s Operational Challenges.”

The program focuses on developing the capabilities of students to work collaboratively in multidisciplinary, cross-cultural teams. Some of the main innovations include the creation of student bi-national teams that will collaborate on joint projects that solve real-world problems posed by industry partners; travel of the student teams to both locations to allow students to act both as hosts and visitors and educate their peers in the local culture, habits and expectations; and the bringing together of academic and industrial partners to promote economic impact. The objective of the 100,000 Strong in the Americas Innovation Fund competition is to increase study abroad in engineering, physics, geology and geophysics. The winning higher education institutions submitted innovative proposals that will create new or build on existing partnerships that increase study abroad opportunities for STEM students. The competition was open to institutions in the U.S., Argentina, Brazil, Colombia, Guyana and Mexico.

“Employers, including this round’s supporter, ExxonMobil, tell us they want many more bilingual, globally savvy staff from the field to their corporate offices,” said Steve Vetter, president and CEO of Partners of the Americas. “The 100,000 Strong in the Americas Innovation Fund is working hard and effectively to achieve this goal.”

The Innovation Fund awards promote transnational institutional partnerships rather than direct scholarships. The announced awards are up to $25,000 each and will leverage commitments from the selected universities to increase student mobility, address institutional barriers that prevent STEM students from studying abroad, and promote study abroad in engineering, physics, geology, and geophysics in the Western Hemisphere.

Adapted from Clemson Media Release, December 18 2015
The Clemson Nanomaterials Center (CNC) was invited to participate in “Space Day – Journey to Other Worlds” celebrations organized by the Roper Mountain Science Center (RMSC) in Greenville, South Carolina on March 12, 2016. This year witnessed over 1,500 visitors, with a wide age group, ranging from five to seventy years in age. This marked the highest volume of visitors since this event’s inception in 2003.

Based on the continuing breakthroughs reported by CNC in open literature, Drs. Puneet, Rao, and Podila were invited to provide their perspective on some of the more promising aerospace applications of nanomaterials, with a focus on space rather than aeronautics, the challenges of integrating nanomaterials into existing aerospace systems, and the challenges that remain for maturation and industry adoption.

To captivate the enthusiasm and unleash the imagination of the visitors, the CNC team demonstrated simple experiments and hands-on activities with the help of its members: Achyut Raghavendra, Anthony Childress, Bipin Sharma, Chuangchang Zeng, Jingyi Zhu, Prakash Parajuli, Sai Sunil Mallineni, and Dr. Sriparna Bhattacharya. Some such activities included the demonstration of thermoelectrics, carbon-based energy storage, and dye-based biosensors for astronauts.

In addition to hands-on demonstrations, a short movie screening and flash animation were used to emphasize the scale of the universe to the nanoworld. The team also demonstrated more fundamental aspects of nanoscience, such as the physical properties of graphene and light-matter interactions at the nanoscale.

This is the second consecutive year in which the CNC has participated in this event, which provides a great opportunity for public outreach and for improving science literacy in addition to inspiring the next generation of scientists and engineers.

Roper Mountain Science Center is a model of collaboration between public and private resources, initially created by the School District of Greenville County teachers and administrators who had a vision for a science center that could provide the district’s 68,000 students with innovative opportunities to experience hands-on science enrichment activities. To find out more about RMSC’s educational programs, please visit www.ropermountain.org
**HOT RESULTS FROM THE ATOMIC PHYSICS GROUP**

Electron beam ion traps (EBIT) are capable of producing several million degree temperature plasmas that can only be found in the solar corona, in distant hot astronomical objects, and in fusion facilities here on Earth. Observing radiation emitted by highly stripped atoms of these plasmas is one of the few options scientists have to learn about the extreme conditions present in these environments.

Members of the atomic physics group are now in a position of having access to two of the handful of EBIT devices around the world to investigate the structure and interactions of highly charged ions. The Clemson University EBIT (CUEBIT) facility was installed in the basement of the Kinard Laboratory three years ago to provide access for different research groups interested in these unique species.

Through a research grant awarded by the U.S. Department of Commerce to principle investigator Dr. Endre Takacs the group now can also take advantage of the unique spectroscopic capabilities of the EBIT lab of the National Institute of Standards and Technology (NIST). The collaborators maintain the NIST Atomic Spectra Database, which allows Clemson students to contribute to one of the most important repositories of atomic data.

Roshani Silwal at the control panel of the NIST electron beam ion trap

*Roshani Silwal and Amy Gall*, graduate students of the Atomic Physics Group conducted their first experiments at NIST during the fall semester. Silwal used the high-resolution extreme ultraviolet (EUV) spectrometer to observe previously unidentified spectral lines of highly charged yttrium ions and found that some of the transitions can be potentially useful for electron temperature and density diagnostics of hot plasmas.

She presented her results at the International Conference on Atomic Processes in Plasmas (APiP) in Paris, France in April, 2016. Amy Gall, also collaborating with high-energy astrophysicist Dr. Marco Ajello, has studied an important atomic process called dielectronic resonance excitation as a potential source for an unidentified line in the stacked spectra of galaxy clusters.

Both Roshani and Gall will have a chance to discuss their results at the Meeting of the Division of Atomic and Molecular Physics of the American Physical Society in Rhode Island at the end of May.

Dr. Takacs’ atomic physics research interest covers the spectroscopy of highly charged ions, the understanding of basic atomic physics processes in laboratory and astrophysical plasmas, and developing diagnostic tools for highly charged ion plasmas. His medical physics program includes the generation and characterization of radiation sources to study the effects of radiation on in-vitro cell cultures and dosimetric modeling and measurements of radiosurgery treatment devices.
GSFC: Fermi Sharpens Its High-Energy Vision

Major improvements to methods used to process observations from NASA’s Fermi Gamma-ray Space Telescope have yielded an expanded, higher-quality set of data that allows astronomers to produce the most detailed census of the sky yet made at extreme energies. A new sky map reveals hundreds of these sources, including twelve that produce gamma rays with energies exceeding a trillion times the energy of visible light. The survey also discovered four dozen new sources that remain undetected at any other wavelength. This image, constructed from more than six years of observations by NASA's Fermi Gamma-ray Space Telescope, is the first to show how the entire sky appears at energies between fifty billion (GeV) and two trillion electron volts (TeV). "What made this advance possible was a complete reanalysis, which we call Pass 8, of all data acquired by Fermi's Large Area Telescope (LAT)," said Marco Ajello, a Fermi team member at Clemson University in South Carolina. "The end result is effectively a complete instrument upgrade without our ever having to leave the ground."

By carefully reexamining every gamma-ray and particle detection by the LAT since Fermi's 2008 launch, scientists improved their knowledge of the detector's response to each event and to the background environment in which it was measured. This enabled the Fermi team to find many gamma rays that previously had been missed while simultaneously improving the LAT's ability to determine the directions of incoming gamma rays. These improvements effectively sharpen the LAT's view while also significantly widening its useful energy range. Using 61,000 Pass 8 gamma rays collected over eighty months, Ajello and his colleagues constructed a map of the entire sky at energies ranging from fifty billion (GeV) to two trillion electron volts (TeV). For comparison, the energy of visible light ranges from about two to three electron volts.


Closer to Home......

On May 9, 2016, the entire Transit of Mercury was visible in the western part of Europe and Africa, in the eastern portions of North America and South America, as well as north of the polar circle.

At right graduate student Amber Porter, who is pursuing a doctorate in physics, focuses in on this celestial event as it takes place right over Sikes Hall!
Feng Ding Wins Top Award to Study Nanoparticles

A Clemson University researcher is using a high-profile funding award to better understand tiny particles that have improved everyday products and shown promise for engineering better medicines, but have also raised concerns about environmental and biological safety. Feng Ding, an assistant professor of physics, is furthering his research into nanoparticles with a $506,569 award from the National Science Foundation’s Faculty Early Career Development Program.

Ding’s research focuses on how nanoparticles change biological materials, including proteins in the human body. Nanoparticles are tens to thousands of times smaller than the width of a human hair. At stake in Ding’s research is the future of nanotechnology, a fast-growing area that is helping create new materials for a range of industries from energy and electronics to healthcare and manufacturing.

Through his research, Ding wants to help ensure that nanotechnology remains safe by better understanding at a molecular level how nanoparticles interact with proteins. The research could also help find medicine to treat maladies that are caused by misfolding proteins, including Type 2 diabetes and Alzheimer’s and Huntington’s diseases. Ding said it felt great to win the award, one of the nation’s top honors for junior faculty members. “As a junior investigator, you work really hard to get some recognition from the experts who know the work and to get them excited about the tool we’re developing,” he said. Terry Tritt, Interim Chair of the Department of Physics and Astronomy, congratulated Ding. “The NSF Career Award is one of the National Science Foundation’s most prestigious awards,” Tritt said. “This is a richly deserved honor for Dr. Ding, who exemplifies the role of teacher-scholar through his outstanding work.”

“If we can figure out what’s causing the problem, we can engineer it to prevent it from creating this bad effect,” Ding said. Ding is also looking to create an anti-amyloid medicine. He’s hope to find nanoparticles that can grab proteins and prevent them from interacting with each other.

Central to his research will be the Discrete Molecular Dynamics tool, or DMD. The tool simulates how molecules move around in the physiological environment. It allows researchers to see how molecules change shape, associate with each other and are covered by nanoparticle surfaces. It also helps predict whether the molecules will change shape.

Ding said the DMD could help other researchers study a vast array of proteins, so part of his award will be aimed at disseminating the tool. He and his team plan to create tutorials and a forum to help train other researchers how to use it. Congratulations on the award also came from Anand Gramopadhye, Dean of the College of Engineering and Science.

“Ensuring the safety of nanotechnology, creating better medicines and disseminating the tools for further scientific discovery are some of society’s biggest challenges,” Gramopadhye said. “This is a well-deserved award, and we are glad to have Dr. Ding at Clemson.”

Clemson Newstand, February 25, 2016 by Paul Alongi
Department News

Amber Porter, Ph.D. student of Dr Mark Leising, will begin as a department lecturer in the fall.

Dr. Hye-Jung Kang has accepted a position with Texas A&M University at Texarkana. We wish Hye-Jung all the best in her new academic endeavour.

Physics Department Chair Terry Tritt and his wife Penny are expecting their first grandson, Gabriel Tritt, who is due in mid-June.

Dr. Xian-Lu has accepted the Department’s offer to be an assistant professor of atmospheric physics, to begin in August.

Dr. Jens Oberheide was promoted to full professor this spring. Jens’ research interests include the dynamics of Earth’s mesosphere-thermosphere-ionosphere system; the propagation of tides, planetary waves, and gravity waves, including their effects on chemistry and electrodynamics. He is also a specialist in satellite data analysis.

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