

Quanta

A publication for the faculty, staff, students, alumni, emeriti and friends of the Department of Physics at Virginia Tech

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From the Chair's desk:

The end of the fall semester is upon us and the first day of winter is just around the corner! As we prepare for final exams here in the department, we can look beyond that to the holidays and the opportunity to spend time with our close family and friends. At home, we started the 8-day Hanukkah celebration already and will be travelling to visit my parents for Christmas and New Years Day.

It is hard to believe that over eight months have elapsed since I was named the department chair, succeeding Beate Schmittmann after she accepted the deanship in Arts and Sciences at Iowa State University. John Simonetti has agreed to continue to serve as the department's associate chair, for which we are all very grateful and appreciative! Four new faculty have joined us this summer—Vinh Nguyen, Will Mather, Duncan Farrah, and Camillo Mariani—and you will find a brief biography of each in this newsletter. Another significant change was the departure of our Business Manager, Ms. Lisa Stables, to ICTAS (one of the research centers on campus). We are blessed to have had Ms. Glenda Dalton step into this role in October, having brought a wealth of experience and sound business practices from her prior work elsewhere at Virginia Tech (most recently in the Music department).

We have a very young faculty now— John Simonetti and I are the old-timers, having both arrived in 1987—and we are all very excited about the prospects for our collective future. We are laying the groundwork now for a long-range strategy to contribute to Virginia Tech's success and eminence through increased research productivity, interdisciplinary, an increase in the number and quality of physics majors and graduate students, growth in our faculty and staff cohorts and, concomitantly, renovation and growth of our research space in Robeson Hall.

Please enjoy this newsletter and drop me a line whenever the mood strikes! I hope you have a joyous and restful holiday season and I offer you best wishes for 2013!

Prof. Leo Piilonen named department chair



Following Prof. Beate Schmittmann's departure to become the dean of the College of Liberal Arts and Sciences at Iowa State University, **Prof. Leo Piilonen** was named chair of the Department of Physics in April 2012. He first joined the department in 1987 and is the William E. Hassinger, Jr. Senior Faculty Fellow in Physics. Popular amongst students, Prof. Piilonen was recognized by the Virginia Tech Alumni Association with the William E. Wine Award in 2011. As a researcher of experimental particle physics, he is the co-spokesperson for the Belle collaboration, a member of the next-generation Belle II collaboration, and a team member of the Daya Bay Reactor Neutrino Experiment.

Wong named interim associate dean, and director of NVC



Prof. Kenneth Wong, assistant professor of physics and director of the Bio-medical Technology Development and Management program, has been named the interim associate dean of the Virginia Tech Graduate School in the National Capital Region, and the director of the Northern Virginia Center in Falls Church.

Wong joined the department in 2009 from Georgetown University. His primary area of expertise is in medical imaging. He has worked closely with Dr. Seong Ki Mun, director of the Arlington Innovation Center for Health Research. Their research in casualty care recently led to the AIC receiving a U.S. Army contract to develop a smartphone for military medics.

In short...

- **Prof. Jean Heremans** has been promoted to the rank of full professor. Additionally, **Profs. Patrick Huber and Eric Sharpe** have been promoted to the rank of associate professor.
- **Profs. Leo Pilonen, Nahum Arav, and John Simonetti** each have been honored with CIDER's teacher-of-the-week recognition.
- **Profs. Randy Heflin, Giti Khodaparast, and Chenggang Tao** participated in this summer's nanoCamp, a two-day educational event geared toward high school students sponsored by the College of Science and the Institute for Critical Technology and Applied Science.
- **Prof. Emeritus Royce Zia** was awarded an NSF-INSPIRE grant to study statistical mechanics of climate variability.
- **Prof. Read Montague** presented a talk about the brain's microprocessing systems at the TEDGlobal 2012 conference in Edinburgh, Scotland. You can view this talk at: http://www.ted.com/talks/read_montague_what_we_re_learning_from_5_000_brains.html.



Please welcome...



Duncan Farrah joined the department as an assistant professor in August 2012. He did his postdoctoral work at Cornell University and the California Institute of Technology. He obtained his Ph.D. from Imperial College London, in the United Kingdom, in 2002. His research interests are to explore the assembly processes of galaxies across the history of the Universe; in particular, how star formation and supermassive black hole growth are triggered, and how they affect each other. Duncan's hobbies include riding horses, playing poker and chess, hiking, and photography.

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William Mather arrived as an assistant professor in August 2012. He has a Ph.D. in Physics from Georgia Tech, where he investigated the theory of molecular motors under the tutelage of Ron Fox. He then went on to complete his postdoc with Jeff Hasty and Lev Tsimring at the University of California at San Diego, where he pursued both theory and experiment in synthetic biology. His current research includes the experimental construction and dynamical modeling of synthetic circuits (DNA programs) in living biological cells, development of microfluidic devices that permit single cell analysis and perturbation of such circuits, and the study of custom synthetic biofilms (living granular media). Due to his diverse research background, Prof. Mather was selected to become an early member of the nascent Integrated Science program, which merges multiple disciplines (Physics, Biophysics, Systems Biology, Bioinformatics, and others) into a seamless undergraduate curriculum. This program seeks to create a new generation of graduates with the breadth and selective depth necessary to succeed in a world permeated with interface sciences.

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Camillo Mariani joined the department as an assistant professor in August 2012. He did his postdoctoral work at Columbia University. Before moving to the United States, he obtained his Ph.D. from Sapienza, University of Rome in 2008. His research interests are focused on neutrinos, the most enigmatic among the zoo of subatomic particles. He is involved in various neutrino oscillation experiments in the US, Europe and Japan. Camillo's hobbies include particle physics, tennis, hiking, biking, cooking and gardening. One of his favorite quotations is: "Between the idea and the achievement, there is one important word: how. And it is the how that makes all the difference."

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Vinh Nguyen joined the department in July 2012 as an assistant professor. He received his Ph.D. from the University of Amsterdam in 2004, and did his postdoctoral work at the Institute for Plasma Physics Rijnhuizen, as well as the University of California at Santa Barbara. His research interests include the terahertz spectroscopy of biomolecules in liquid water, as well as the structure and dynamics of aqueous solvation shells.

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Faculty, staff honored with Excellence in Access and Inclusion Awards

On April 3, 2012, Services for Students with Disabilities and The Office for Diversity and Inclusion honored three Physics faculty and staff members for their tireless efforts in providing a welcoming learning environment for all students.

Dr. Kriton Papavasiliou and **Prof. Leo Piilonen**, as well as undergraduate program coordinator **Diane Walker-Green**, each received the 2012 Excellence in Access and Inclusion Award.



Dr. Papavasiliou was honored for helping students grasp and better understand physics concepts. Said the student who nominated him, "He has readily made himself available by holding several office hour sessions throughout the week and meeting with students before and after class. Dr. Papavasiliou also goes to great levels to help me and other students understand our errors on exams and homework assignments, and helps us overcome them. He is very respectful to my accommodations and goes out of his way to help me meet them, which creates a positive learning environment."

Prof. Piilonen, who recently became department chair, was nominated by the SSD office and Assistive Technologies for his cutting edge work into transferring Braille Nemeth Code in LaTeX files for a student with a visual impairment. He has presented his work to the Annual Conference on Higher Education Pedagogy.

Fellow staff member Jo Ellen Morgan wanted Diane Walker-Green to be recognized for "going beyond the role of an advisor to make sure that the complex needs of students with disabilities are met. Diane works with students with disabilities to ensure not only accessible textbooks and materials, but to help the students be well integrated in the physics and university communities."



Additionally, Prof. Piilonen was the recipient of the 2012 Sally Bohland Award for Exceptional Leadership in Access and Inclusion. Established in 2011, this award goes to a teaching faculty member who is a model for others, whose leadership fosters a culture of access and inclusion, and who modifies or develops their instructional methods to be more inclusive for all students, not just providing accommodations, but improving access on many levels.

Introducing...



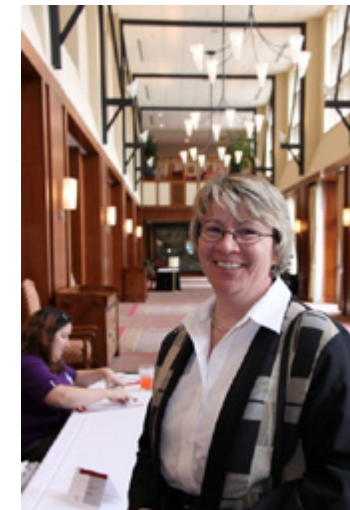
Glenda Dalton joined the Department of Physics as Business Manager in October, 2012. Glenda first started working for Virginia Tech in 1999 as a Fiscal Technician/Bookkeeper. Since then, she has served on campus as an Accounting/Payroll Manager and an Executive Assistant/Business Operations Coordinator. She is married and has one son.



Henry Hilgendorf is the assistant to the lab manager, Josh Peebles. Henry's job is to help make sure that the labs, demos and outreach trips are able to be done on time. He graduated from the Virginia Tech Physics Department in 2011 and worked at Best Buy for a year. Dur-

ing his off time he likes hiking, biking, and anything in water. In the future, Henry plans on enrolling in the PhysTEC Masters of education program to become a teacher.

Farewell and best wishes...



Prof. Beate Schmittmann

In April, **Prof. Beate Schmittmann** left her role as department chair of six years to become the dean of the College of Liberal Arts and Sciences at Iowa State University. Under Beate's leadership, the department saw a swell in the number of graduate and undergraduate students, as well as growth in the research fields of particle physics, biomedical physics, and nanoscience. She is a proponent of women's advancement in science and engineering fields. We wish Beate all the best in her new role as a dean and as an ISU Cyclone!

Lisa Stables, who served as Business Manager for four years, bid farewell to the department in September to become the Fiscal Team Manager at the Institute for Critical Technology and Applied Science (ICTAS). Our faculty, staff, and students will miss seeing her smiling face on a daily basis, but we wish her best of luck in her new role on campus!



Lisa Stables (center)

Center for Neutrino Physics hosts international Summer School



The Center for Neutrino Physics at Virginia Tech hosted the International Neutrino Summer School in Blacksburg on July 9-20, 2012.

The goal of this annual event is to train the next generation of neutrino scientists. Nearly one hundred people from seventeen countries spanning four continents attended the school this year. Fifteen invited speakers gave presentations ranging in topic from the Standard Model and oscillation phenomenology to neutrinos in cosmology.

In addition to the lectures, participants were able to take part in dinners at the Hahn Horticulture Garden and at Mountain Lake. Attendees also had the opportunity to hike The Cascades in nearby Giles County.

Department honors Dr. Raju Raghavan's legacy with symposium

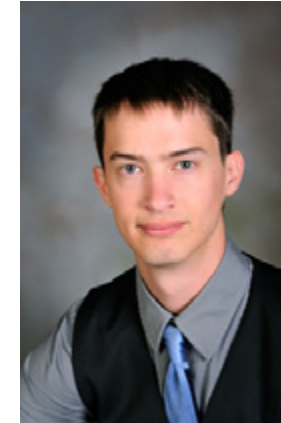
Fifty of Dr. Raju Raghavan's family, friends, and colleagues gathered on October 20, 2012 to remember his life and his contributions to science on the one-year anniversary of his passing.

As part of the Symposium on the Life and Science of Dr. Raju Raghavan, fond memories were shared of his life as a graduate student, his career at Bell Labs, and his contributions to the Borexino experiment, the KamLAND experiment, and many others. Some of the attendees could not make it to Blacksburg for the event, so the talks were streamed live via the Internet.



The presentations are available on YouTube at:
<http://www.youtube.com/user/RajuRaghavanMemorial>

Charles Baker awarded NSF Graduate Research Fellowship



Charles "Casey" Baker (class of 2012) was awarded a graduate research fellowship from the National Science Foundation.

The National Science Foundation's Graduate Research Fellowship Program (GRFP) recognizes and supports outstanding graduate students in NSF-supported science, technology, engineering, and mathematics disciplines who are pursuing research-based master's and doctoral degrees at accredited US institutions.

Casey is currently pursuing graduate studies at Harvard University.

Student publications

- **Dr. Qian He** published in *European Physical Journal B*. (May 2012)
- **Dr. George Daquila** published in *Physical Review Letters*. (May 2012)
- **Linjun Lin** published in *Europhysics Letters*. (June 2012)
- **Casey Baker** and **Tao Jia** published in *Physical Review E*. (June 2012)
- **Sara Case** ('12) and **Clinton Durney** ('11) published in *Journal of Statistical Mechanics*. (July 2012)
- **Ahmed Roman** ('13) and **David Konrad** ('12) published in *Journal of Statistical Mechanics*. (July 2012)

Spotlight on: Awards Day 2012



The Department of Physics hosted its annual awards ceremony on Friday, April 13, at the Graduate Life Center. Awards were presented to forty students in honor of their academic excellence in undergraduate and graduate studies.

Pamela Granger (class of 2004) gave the keynote address. She spoke of her memories of Virginia Tech and how her experiences in the department prepared her for a career in intel-

lectual property law.

Next year's awards ceremony will be held on April 12, 2013. Be sure to read the next issue of *Quanta* for all the details!

Sophia Novitzky takes Bowden essay prize

Sophia Novitzky (class of 2015), a Ukrainian-born sophomore double-majoring in physics and mathematics, was awarded the 2012 Robert Lee Bowden Essay Prize at the annual departmental awards ceremony on April 13.

The Bowden Essay Prize was established in 2008 to reward excellence in science writing. Today, good writing skills are becoming ever more critical, as most career paths require communication with non-technical audiences.

Below is Sophia's essay, in its entirety:

Mpemba Effect: is it More Than a Water-Cooler Talk?



Novitzky, with Dr. Robert Bowden

What happens when two containers, filled with water of different temperatures, are placed in a freezer? The intuitive answer seems obvious: cold water will freeze faster. However, it often appears to be the exact opposite – the hot water freezes before the cool water does. First mentioned by Aristotle more than 2300 years ago, the observation was later rediscovered by Erasto Mpemba. This high school student from Tanzania (Africa) was running late in a cooking class. Mpemba placed a hot ice-cream mixture in a refrigerator and noticed that it froze faster than the cooler ice-cream mixtures placed there by his classmates. The phenomenon is now known as the Mpemba effect (Jeng). Let us look into some physics to figure out what is going on.

Naturally we assume that the hot water first has to cool down to the temperature of the cold water before it starts freezing the same exact way as the cold water did. If this was true, the hot water would have no option but to freeze slower than the cold water, which contradicts the mere existence of the Mpemba effect. We thus conclude that the processes in the two containers have to somehow differ.

The first difference that comes to mind is the process of evaporation. Indeed, some of the hot water will evaporate, leaving the remaining water at a lower temperature and a smaller mass. Yet, according to the Department of Physics from the University of California, experiments hint to us that evaporation is not so great of a factor, since we observe the Mpemba effect in closed containers as well (Jeng).

The next best guess to look at is the possible chemical difference between the containers. Both contain just plain water, but the hot water contains less dissolved gas. When we boil water, the endless bubbles rising up in the kettle are carbon dioxide and oxygen. They leave the water, and by doing so, potentially arouse the Mpemba effect. How can that happen? Well, the scientists tell us: the gas in the water affects its properties (Hedenquist, Henley). Specifically, gas decreases the temperature at which the water begins to freeze. Thus, the hot water,

which has less gas, gets a small benefit of freezing at a higher temperature. However, such an explanation may not be the best. The physicists from Georgia State University say that those few degrees (or perhaps tenths of a degree) alone cannot make a significant change.

Let us consider the dynamics of water in hope of a more reliable explanation. The temperature is not uniform throughout the container - warmer water rises to the surface and colder water flows to the bottom. At the top of our container, the water cools down from the chilly fridge air, and is then replaced by the warmer water from underneath. This movement of water within a container is called the convection currents. In either container, these currents cannot form immediately, and here is when the initial temperature of the water comes into play. In our cool-water container, by the time the warm water begins to replace the chilled surface water, a layer of ice is formed. The frozen top is crucial to the overall cooling of the container, since ice is a great heat insulator. We observe this concept in nature all the time: the surface of a pond freezes in the winter, but the water underneath stays warm, allowing the fish to survive the winter. Now, in the hot-water container, the top layer of water takes longer to freeze. Thus, the warmer water from the bottom has enough time to stimulate convection currents and replace the surface water before it freezes. Once the convection currents form, they keep the water circulating within the container, and allow the entire container of water to cool down much faster before freezing takes place.

The Mpemba effect is fun to explore, and perhaps even to test. However, is it any useful? Beyond small applications, such as saving time while freezing skating rinks or making ice-cream, the phenomenon DOES potentially affect more important issues. For example, uninsulated hot water pipes freezing in the winter may lead to disasters. In fact, anything can happen, unless proven impossible. An infamous case of a neglected phenomenon is the frequency resonance, which was not considered during a bridge construction. The Tacoma Narrows Bridge, one of the largest suspended bridges of its time, collapsed in 1940 because the wind reached an unlikely high speed. Strong air currents caused the bridge to vibrate with an increasing amplitude, and eventually, Tacoma's concrete construction came crushing down (Knill). Although the Mpemba effect did not cause any known catastrophes, we should still keep the phenomenon in mind. One has to think ahead and take every possibility into consideration regardless of how unlikely the possibility may seem.

What's your story? Got married? Added a new member to the family? Landed your dream job? If so, we'd love to share your good news in future issues. Visit www.phys.vt.edu for contact information, or use the form below. Mail your completed form to: **Department of Physics at Virginia Tech, 123 Robeson Hall, Blacksburg, VA 24061-0435.**

NAME: _____

CLASS: _____

E-MAIL ADDRESS OR PHONE NUMBER: _____

YOUR GOOD NEWS: _____



Keep up with all of the Physics department happenings with a scan of your smartphone!

Lectures delve into mysteries of time flow and dark matter

Crowd welcomes Nobel laureate with reception fit for a rock star

Organizers of **Sir Anthony Leggett's** public lecture on March 22, 2012 knew that the audience would be talking about it for days to come. What they did not count on was the magnitude of that audience.

An estimated 400 people turned out to hear the Nobel Prize-winning physicist talk about using quantum physics to unlock nature's mysteries. The talk, titled "Why Can't Time Run Backwards?" was moved at the last minute from The Inn at Virginia Tech to a lecture hall in Hahn Hall-North Wing to accommodate the crowd. In fact, Sir Leggett graciously agreed to hold two talks that night so that everyone who came could hear his lecture.

To view Sir Leggett's lecture in its entirety, please visit our YouTube page:

<http://www.youtube.com/TheVTPhysics>



Author, CEO explores usage of "gravitational lensing"

Astrophysicist and author **Dr. Evalyn Gates** introduced "gravitational lensing" to the public when she visited campus on March 29, 2012.

In her talk titled "Einstein's Telescope: The Hunt for Dark Matter and Dark Energy," Dr. Gates focused on a technique that allows scientists to use space itself as a telescope. It can be used to "map out the filaments of dark matter that wind throughout the Universe and to trace the imprint of dark energy on our



expanding and evolving cosmos." In using gravitational lensing, we may one day be able to answer the questions surrounding what the universe is made of.

Dr. Gates is the CEO of the Cleveland Museum of Natural History and has written a book by the same title as her lecture. She was previously the Assistant Director

of the Kavli Institute for Cosmological Physics at the University of Chicago and a Senior Research Associate in the Department of Astronomy and Astrophysics there.

Transit of Venus event draws skywatchers from around the NRV

On June 5, 2012, an estimated 500 people from around the New River Valley gathered near Hahn Hall-North Wing to witness a once-in-a-lifetime event: the transit of Venus. The family-friendly event was hosted by astrophysics graduate students **Brandon Bear** and **Brian Roper**, who set up telescopes with a special filter that allowed viewers to track Venus as it passed in front of the sun.



Unfortunately, the fickle Blacksburg weather provided spectators with heavy cloud cover that prevented such a viewing. Not to worry: the event organizers projected live footage from NASA's Web site in an indoor classroom, allowing those inside the lecture hall to catch a glimpse of the phenomenon as it unfolded.



Although the weather was uncooperative, a crowd of around 100 diehards still remained outside, hoping for the sun to peek through the clouds.

The next time Venus will transit across the sun: the year 2117!

Photo credit: Matt Gentry of The Roanoke Times



Quanta 2012

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Contributions by: Glenda Dalton, Duncan Farrah, Henry Hilgendorf, Camillo Mariani, Vinh Nguyen, Will Mather, Sophia Novitzky

The Physics Department Annual Fund



One person can make a big difference!

The Department of Physics is seeking strongly enhanced national and international recognition for its research and educational programs. With excellence in nanoscience, complex systems, particle physics and astrophysics, the department is already targeting areas of nationally recognized importance. By strengthening these efforts and expanding into interdisciplinary opportunities in biophysics and medical physics, we will position the department at the leading edge of scientific discovery for many years into the future. We will continue to set high standards of excellence in undergraduate and graduate education, focused on fundamental principles and emerging frontiers.

Your support will be critical for our success. Any monetary contribution you make could be used to expand and renovate Robeson Hall, fund a student scholarship, establish a fellowship or professorship in your name, or fund a postdoctoral research position. When you receive your College of Science Annual Fund letter or phone call, please earmark your support for the Physics Department. Simply make a notation on the gift card or let the caller know that you want to direct your donation to the Physics Department. You can also visit our Web site, <http://www.phys.vt.edu/giving>, or call gift accounting at 1-800-533-1144. For more information or to learn more about other ways to give, please contact Jenny Orzolek, Director of Development for the College of Science, at 540-231-5643 or jorzolek@vt.edu. We thank you in advance for your support.

Physics in Your Neighborhood!

Alumni Reunion – 2013 March Meeting of the APS in Baltimore, MD (date and restaurant TBD)
For more information, go to <http://www.phys.vt.edu/events>