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

Message from the Chair:

It is a pleasure to sit down near the end of the year and write this message. The only challenging part is that with so many talented, energetic people in the department and so many things going on, it is difficult to keep it to a single page!

We began the year in January by welcoming about 140 undergraduate women in physics to campus for the American Physical Society Conference for Undergraduate Women in Physics. You can read more about this successful event organized by Professors Khodaparast and Anderson in this issue. In February, there was a reception where we formally received (along with the Biological Sciences and Chemistry Departments) our 2016 University Exemplary Department Award. I mentioned this in last year's message because we had just received notification of it then. We were honored for the theme of developing and sustaining effective large class instruction. That success relies on the contributions of a large number of faculty, students, and staff, so it was a nice recognition for the whole department. And the College of Science for that matter… I heard Dean Morton proudly tell the story of three of her departments getting this award several times this year. In April, we had our annual Awards Day Luncheon, when we welcome students, parents, alumni, and benefactors for a lunch celebrating the academic success of our students. This event grows in attendance every year; this year it was big enough that we needed to hold it in the Latham Ballroom at the Inn at Virginia Tech. As always, we are grateful to the many benefactors that provide the financial support to recognize our student's accomplishments in this very significant way. Finally, the department and College of Science were treated throughout the year to four public lectures from very distinguished guest speakers through the J. Mark Sowers Distinguished Lecture Series. Read more about it in this issue.

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This has been my first full year as chair, and a particularly enjoyable part of this year was our faculty hiring season in early spring. The chair spends significant time with each of the candidates, and I came away from those interactions revitalized due to the enthusiasm and energy of our candidates. There is remarkable talent out there, and I am pleased that we have been able to continue to attract and hire excellent colleagues. This year resulted in two new hires. Dr. Satoru Emori joined us this fall from Stanford University. He works in the area of experimental condensed matter physics, and you can read more about him in this newsletter. Dr. Rana Ashkar will join us next month in January from Oak Ridge National Laboratory. She works in the area of experimental biophysics. We will have a full story on her in next year's newsletter.

Please also commiserate with us as we mourn the passing of one of our long-time colleagues, Professor Paul Zweifel. Paul was a leader in the mathematical development of transport theory. He was honored with a memorial session at the 25th International Conference on Transport Theory in Monterey, CA in October, particularly appropriate since this was a conference series he founded. The session was attended by many friends, including Italian colleagues who sang in his honor.

Our department continues to have a record number of students. Just a few years ago, we tripled the number of freshman physics majors, and now we are beginning to see that affect the size of our graduating class. We had 47 undergraduate majors graduate this past May, and we expect over 50 to graduate next year. Our graduate program continues strong with about 85 students enrolled in Fall 2017. Even with increased numbers, we continue to preserve our supportive "family" atmosphere that I hope many alumni remember fondly. I pass by our undergraduate majors room every day; it is full of students who know they have a welcome home in Robeson.

I hope you enjoy this newsletter. Feel free to drop me a line or even better, should you be in Blacksburg come and see me in Robeson Hall. It would be great to catch up and introduce you to new arrivals since you left.

Happy Holidays!

COLLEGE OF SCIENCE

VIRGINIA TECH

John Simonetti part of worldwide effort in detection of two merging neutron stars and resulting explosion

An international group of scientists, including Virginia Tech's John Simonetti, recently announced they had detected a kilonova — a collision of two neutron stars that unleashed a set of gravitational waves into outer space.

The discovery — made in light waves and gravitational waves — set the science world abuzz with headlines ranging from scientific journals to the New York Times. Simonetti, a professor and associate chair in the College of Science's Department of Physics, said, "No other worldwide astronomical effort has ever come close to this coordinated effort."

The unprecedented detection happened on Aug. 17. Scientists, using the Laser Interferometer Gravitational-wave Observatory (LIGO for short), detected gravitational waves, aka ripples in space-time, from the collision of two neutron stars 130 million years ago. Additional astronomers, representing some 70 observatories, announced they detected the resulting explosion. This marks the first time a cosmic event has been viewed in both gravitational waves and light.

This news comes on the heels of a spectacular month for LIGO researchers, who recently won the 2017 Nobel Prize in Physics for their fall 2015 discovery of a gravitational wave event caused by the spiraling merger of two black holes that took place 1.3 billion years ago. Since 2015, LIGO scientists have detected other black hole collisions from the gravitational waves emitted during those mergers.

The 2015 discovery by LIGO confirmed predictions of Albert Einstein's century-old theory of general relativity, which included the existence of gravitational waves — ripples in the space-time fabric.

LIGO scientists said the latest effort was made using its U.S.-based gravitational-wave observatory, the Europe-based Virgo gravitational-wave detector, and some 70 ground- and space-based astronomical observatories, including the Long Wavelength Array (LWA) in New Mexico, the radio telescope used by Simonetti and his team.

"These world-wide, coordinated, multi-messenger observations, with so many independent science teams, including Virginia Tech, are unprecedented in astronomical history," Simonetti said.

In a news release, LIGO stated that neutron stars are the smallest, densest stars known to exist and are formed when massive stars explode in supernovas. As these neutron stars spiraled together, they emitted gravitational waves that were detectable for about 100 seconds on Aug. 17. When they collided, a flash of light in the form of gamma rays was emitted and seen on Earth for about two seconds following the gravitational waves. In the following days and weeks, other forms of light, or electromagnetic radiation — including X-ray, ultraviolet, optical, infrared, and radio waves — were detected, according to LIGO.

Using the LWA, Simonetti and his team looked for the resulting fireworks caused by the material and energy explosively ejected during the collision.

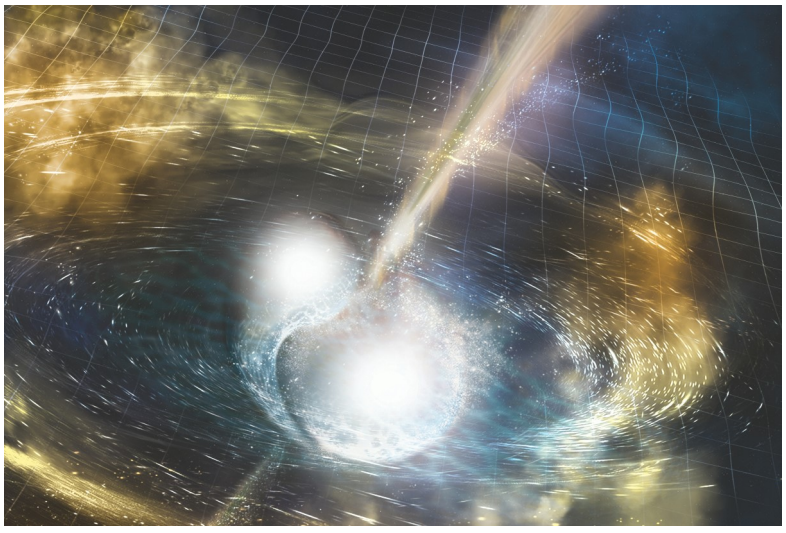
"Our observations were among the first follow-up observations after the communication of the gravitational wave event by the LIGO/Virgo Collaboration to the collaborating astronomers, certainly the first in the radio spectrum," Simonetti said. "Our observations were at the lowest radio frequencies. Both the quickest response and the lowest frequencies may provide vital information to help understand what occurred when these two neutron stars merged."

In the latter stages of such a dramatic ejection of energy and material, some of the light, particularly at radio wavelengths, is probably caused by the collision of the ejected high energy particles with the surrounding, ambient interstellar gas, said Simonetti. Think of it in an analogy as seeing not the blast of a bomb's explosion, but instead the thudding effects of the shrapnel as it hits nearby buildings.

"This merger of two neutron stars is the sort of event LIGO and Virgo were designed to detect," Simonetti said. "This is the type of merger event that should be more common, compared to black hole mergers."

The results of the complete "multi-messenger" campaign were published in The Astrophysical Journal Letters. Joining Simonetti as co-authors are physics undergraduate researcher Kaila Nathaniel, a junior from Springfield, Virginia; doctoral alumnus Michael Kavic, now an associate professor at Long Island University in Brooklyn, New York; and physics doctoral student Jr-Wei Tsai.

"Much more work will need to be done," Simonetti said. "We will be further analyzing our data and will produce a separate paper. Additionally, we will continue to observe to see if brighter radio emission is released that we might detect at low frequencies. There is some indication that the radio emission is growing in strength."



Written by Steven Mackay

VT News October 23 2017

Physics researchers eye experimental box as key to tracking nuclear activity by rogue nations

Researchers at the Virginia Tech College of Science are carrying out a research project at Dominion Power's North Anna Nuclear Generating Station in Virginia that could lead to a new turning point in how the United Nations tracks rogue nations that seek nuclear power.

The years-long project centers on a high-tech box full of luminescent plastic cubes stacked atop one another that can be placed just outside a nuclear reactor operated by, say, Iran. The box would detect subatomic particles known as neutrinos produced by the reactor, which can be used to track the amount of plutonium produced in the reactor core.

It is plutonium — the key ingredient in nuclear weapons — that U.N. regulators seek to track in all nations that are party to the Nuclear Non-proliferation Treaty, but particularly in nations seen as volatile. The Virginia Tech team calls the box "tamper proof" and says if successful, can all but eliminate instances of falsified paperwork or uneasy inspection visits.

"If they want a nuclear reactor, we can let them build it and detect its activity with a minimal impact on its operations," said Jonathan Link, a professor in the Department of Physics, part of the College of Science. Link views nuclear energy as an important part of a new worldwide low-carbon future that nevertheless requires careful oversight from all participating nations to ensure its safety.

Link believes rogue nations that balk at having to submit to inspections would have no reason to refuse such a small, unobtrusive device. The cube is an early prototype — roughly a two-foot cube, with an active volume weighing 175 pounds — but Link and his team say with enough data collected during several months of testing at North Anna, it could soon justify to larger detectors operated by the International Atomic Energy Agency at facilities around the world.

Dubbed CHANDLER, this project is part of Virginia Tech's Center for Neutrino Physics, of which Link is director. Together with fellow physics faculty and center members Patrick Huber and Camillo Mariani, he predicts the current detector, a prototype known as MiniCHANDLER, will demonstrate the potential for a future larger detector weighing in at a few tons. The cube now sits just at the base of the concrete containment building of North Anna's reactor 2, inside a small trailer dubbed the Mobile Neutrino Lab that contains a rack full of processors, all cooled by two air-conditioning units. The trailer will stay at North Anna for several months. On a recent trip, Link set the trailer up, starting data collection, with the ability to beam data wirelessly to Virginia Tech's Blacksburg campus.

The North Anna Nuclear Generating Station is located near Mineral, Virginia, roughly 100 miles southwest of Washington, D.C.

Created in large amounts during plant operation, the cast-off neutrinos that escape the reactor cannot be shielded or disguised, thus creating a foolproof tracking system for regulators, Link said. There is a challenge in separating neutrinos created by the reactor from everyday radioactive "noise" from the ground or raining

down from energetic cosmic particles slamming into the Earth's atmosphere, but Link and his team are confident they can extract a signal solely from the reactor neutrino output.

Up until now, neutrinos produced during nuclear fission could not be detected except with a massive machine the size of a house or built very close to the reactor, near impossible to deploy in a rogue nation.

How does the box work? If your career is nuclear physics, it's easy. If not, well, it's complicated. Roughly: The light-tight, high-tech box is packed with hundreds of small wavelength-shifting plastic scintillator cubes — they appear green in natural light — that carry the chore of detecting neutrinos emitting from a nearby reactor. When a neutrino interacts in the cube, it creates a small flash of light that can be recorded and tracked. The detection of light can then be sent remotely to researchers either nearby or hundreds of miles away, according to initial research plans by Link and his team.

"The whole problem with nuclear inspections is you have to know what is happening at all times to make this calculation," Huber said. "You need continuity of knowledge to make conclusions. But the stream of data from a reactor can be interrupted because of technical malfunction or diplomatic reasons. With antineutrino detection, you don't have to know all that. It's based simply on the detection of neutrinos."

Anna Erickson is an assistant professor of the Nuclear and Radiological Engineering Program at Georgia Tech, where she researches nuclear reactor design and nuclear detection with a focus on the needs for proliferation-resistant nuclear power. She is not involved with the CHANDLER project, but said the neutrino project by Virginia Tech could set a new standard for antineutrino detectors, a field stalled by tricky technology, including the sizes of previous devices too large for easy assembly, transport, and setup. Previous detectors used liquid scintillators, rather than solid plastic as does CHANDLER.

"This could open a new path for antineutrino-based reactor monitoring technology," she said.

The challenge of working detectors around the globe are many. In addition to perfecting the technology itself, getting rogue nations to agree to placement "can be as much of a challenge as advancing the technology itself," Erickson said.

The box has a scientific mission, too: searching for a possible fourth type of neutrino, known as a sterile neutrino. The sterile neutrino is the focus of a long-running scientific mystery story. Several experiments have identified weak hints for a sterile neutrino while other experiments were inconclusive, Link said.

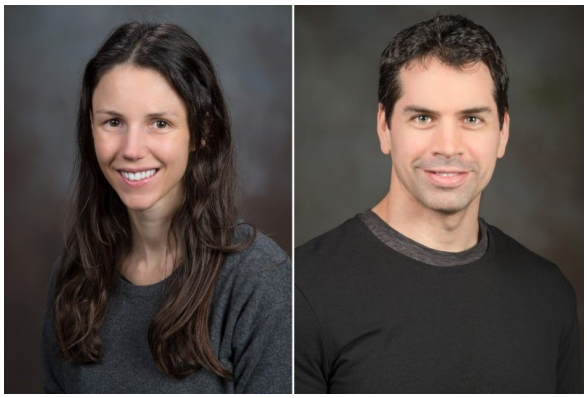
"If a sterile neutrino exists and were to be discovered by us, that would be a paradigm-shifting discovery in particle physics whose impact cannot be overstated," Link said, adding that several small-scale experiments are now taking data or preparing to take data in the near future to address the mystery of sterile neutrinos. "The CHANDLER detector represents a significant improvement in the state-of-the-art, and if the funding comes through we may still have a chance to compete for a discovery."

Funding for the CHANDLER project has come from the National Science Foundation and Virginia Tech, including the Institute for Critical Technology and Applied Science and the Institute for Society, Culture, and Environment.

Written by Steven Mackay

VT News August 2, 2017

Physics researchers hosting NSF-funded workshop on quantum information, future of communications security



Virginia Tech Department of Physics faculty will lead a three-day workshop in Arlington, Virginia, focused on encouraging convergent research in quantum information, which could provide communications a revolutionary boost in security and privacy.

Sophia Economou, associate professor, and Edwin Barnes, assistant professor, both of physics in the College of Science, are heading the National Science Foundation-funded (NSF) workshop titled "Quantum Leap: Workshop on Quantum Elements of Secure Communication." The workshop is part of a larger NSF effort, called Growing Convergent Research, that addresses five of the federal agency's 10 Big Ideas for Future NSF Investments, with the five including data revolution; the "new" arctic; human-technology frontiers; predicting phenotypes, and the topic led by Economou and Barnes, quantum communication.

The workshop will be held Dec. 3-5 at the Virginia Tech Research Center – Arlington, Virginia Tech's base in the Northern Capital Region. Roughly 45 attendees from universities, national laboratories, and government agencies are expected. The participants were chosen from a broad range of backgrounds and disciplines, including physics, engineering, computer science, mathematics, and chemistry.

"Our workshop will identify challenges and opportunities in the field of quantum communications, and how convergence – deep and sustained collaborations across scientific disciplines – will advance discovery and innovation in this field," said Economou, who joined the physics department in 2015. "The workshop will involve extensive discussion in small groups in addition to four presentations each day."

Quantum mechanics carries the potential to revolutionize communication security because of basic principles that forbid the copying of quantum information and enable the detection of an eavesdropper, marking a potential boom in individual privacy and national security, according to Economou and Barnes.

Yet, a challenge with building such networks is the fragile nature of quantum information, which makes designing communication protocols, engineering components, and integrating the two an ambitious interdisciplinary undertaking, the researchers added. To tackle these roadblocks, researchers in the fields of single-photon sources, nanophotonic engineering, optical networks, single-photon detectors, and quantum communication theory will give presentations, followed by small-group brainstorming sessions.

The workshop will address a central issue of the NSF's Quantum Leap Big Idea, related to development of secure and scalable modes of communication based on quantum phenomena, according to a news release from the federal agency. Additional university winners funded by NSF in the category of "The Quantum Leap" include the University of Chicago and a third team comprised of researchers from MIT, Johns Hopkins University, Cornell University, and Penn State University. These workshops will be held at separate dates and locations.

"Quantum computation and communications is a major area of interest for countries and leading international corporations," said Mark Pitt, chair of the physics department. "Ed and Sophia have quickly established a major program in quantum information science at Virginia Tech, and this award is a significant recognition of their leadership. I'm pleased that our research directions at Virginia Tech are well-aligned with what the National Science Foundation views as a big idea for future investments."

Written by Steven Mackay

VT News November 28, 2017

Michel Pleimling named director of inclusion and diversity for College of Science

Michel Pleimling has been named director of inclusion and diversity in the Virginia Tech College of Science, with a mission of helping create a faculty, student body, and community that is diverse and welcoming.

A professor of physics and director of the Academy of Integrated Science in the College of Science, Pleimling will plan, implement, coordinate, and assess the college's continuing efforts in advancing inclusivity for, and diversity of, all college stakeholders, including students, faculty, and staff.

"Dr. Pleimling brings deep experience and true dedication to meeting the challenges that issues of inclusion and diversity present within academia," said Sally C. Morton, dean of the College of Science. "Working closely with our dedicated university partners, as well as our departmental diversity committees, he will lead our efforts to create a faculty, student body, and community, that is welcoming of the vast array of cultures and perspectives through which we strengthen ourselves, our work, and the world around us."

Among the goals of the director is to advance diversity and inclusion at the student level by recruiting and retaining a diverse body of students, an effort aided by recruiting a diverse faculty and staff. At all programs within the college, a high value is placed on inclusion and cultural competence in the education of its 4,500 students, in addition to all students who take courses within the college. It is estimated that the college through its faculty and instructors teach an estimated 248,000 credits hours per year.

Diversity is among the college's core values, which also include excellence and discovery, all built on the spirit of the university motto of Ut Prosim (That I May Serve). As seen in the College of Science's vision, mission, themes and values statement, "Diversity is an ethical, pragmatic, and essential component of science. Ethical in the sense that opportunity should be provided to all and such opportunity results in a more dynamic community of faculty, staff and students. Pragmatic as we must welcome all in order to attain a sufficient scientific workforce to tackle today's many problems. Essential because inclusion of disciplines, ideas, insights, and values is fundamental for strong science."

The College of Science's core values rest on the Virginia Tech motto of Ut Prosim and the spirit of a land-grant institution pervades all that it does. The college imparts and models this fundamental mission of service to its students so they also will carry it forward in their professional and personal lives.

Prior to his new appointment, Pleimling was involved with two major initiatives aimed at advancing diversity on campus, with one initiative serving faculty and the other serving undergraduate students. He is a member of the AdvanceVT/InclusiveVT faculty committee, dedicated to institutionalize campus-wide and college-wide best practices for diversity recruitment and retention of faculty.

Pleimling has served on the University Curriculum for General Education / Commission on Equal Opportunity and Diversity Joint Subcommittee, which has reviewed the Pathways General Education Curriculum in order to find ways to incorporate diversity throughout the entire university.

"Diversity both of people and perspectives is the key to our goal of strengthening the college's core mission of pursuing excellence in science and discovery," said Pleimling. "Through my involvement in these initiatives I realized that much work remains to be done in order to achieve a truly diverse and inclusive campus and College of Science."

"In the past year, I have witnessed the depth of Professor Pleimling's commitment to issues of diversity and inclusion," said Menah Pratt-Clarke, vice president for strategic affairs and vice provost for inclusion and diversity at Virginia Tech. "Consistent with InclusiveVT, his individual commitment has been exemplified through his service on the AdvanceVT/InclusiveVT Faculty Committee to advance faculty diversity, his support for the life science peer mentoring project for underrepresented and underserved students, and his advocacy and promotion of inclusive pedagogy with his College of Science peers."

Written by Steven Mackay

VT News March 24, 2017

Virginia Tech hosting American Physical Society's Conference for Undergraduate Women in Physics

Virginia Tech will serve as one of 10 regional hosts for the national 2017 American Physical Society Conference for Undergraduate Women in Physics (CUWiP).

More than 140 students, including 130 from around the Southeast United States, are expected to attend the Blacksburg-based regional event, to be held Friday–Sunday, Jan. 13-15, 2017.

This marks the first time that Virginia Tech has hosted the national event designed to help undergraduate women continue in physics by providing them with opportunities to experience a professional conference, receive information about graduate school and professions in physics, and enjoy access to other women in physics of all ages with whom they can share experiences, advice, and ideas.

Events at Virginia Tech this year include research talks, panel discussions about graduate school and careers in physics, workshops and discussions about women in physics, student research talks and poster session, and laboratory tours.

"We strongly believe this conference provides inspiration for future generations of female scientists, allowing them to connect with peers and mentors and to engage in dialogues not always possible at their home institutions," said Giti Khodaparast, an associate professor in the Virginia Tech Department of Physics, part of the College of Science, and one of the key event organizers. "We will have five female faculty, one physics teacher-in-residence, and many female graduate and undergraduate students involved in organizing this event. We have the perspective and personnel to make this conference a success."

Added co-organizer Lara Anderson, an assistant professor of physics, "The CUWiP conferences have become a powerful tool to support and encourage female STEM students. According to the American Physical Society's data, there are now nearly as many female students attending CUWIPs each year as there are women graduating with physics degrees in the United States. This means that we have a chance to collectively connect with a whole generation of students. I'm excited to have that opportunity."

The keynote national speaker is Professor Nergis Mavalval of the Massachusetts Institute of Technology, a recipient of the 2010 MacArthur Foundation "Genius" Award and a leading scientist with the Laser Interferometer Gravitational-wave Observatory (LIGO) project, which has detected gravitational waves. Her address will be shown via webcast for all CUWiP members. Speaking at

Virginia Tech will be Professor Laura Greene of Florida State University, incoming president of the American Physical Society.

Local speakers also include Virginia Tech community members who have actively worked in campus STEM (Science, Technology, Engineering, and Mathematics) diversity and inclusion efforts, including College of Science Dean Sally C. Morton; Menah Pratt-Clarke, vice provost for inclusion and diversity and vice president for strategic affairs; and Bevlee Watford, associate dean for academic affairs with the College of Engineering and director of the college's Center for Enhancement for Engineering Diversity.

"The College of Science is proud to serve as a host for this year's Conference for Undergraduate Women in Physics," said Morton, who will open the event with a talk on Friday night. "I can think of no better way to start the new year in our college than bringing together young women with experts in the fields of physics and science for a weekend of discussion and learning. Hosting this event fits exactly with our college core values of science excellence, discovery, diversity of people and ideas, and service."

The Virginia Tech event is being hosted by the Department of Physics, the Center for the Neutrino Physics, the College of Science, the Office of Vice Provost for Research, Office of Vice President for Undergraduate Education, AdvanceVT, the Graduate School of Virginia Tech, the Multicultural Academic Opportunities Program, Virginia Tech's Institute for Critical Technology and Applied Sciences, and Case Western Reserve University's Office of Inclusion and Diversity.

Additional North American universities hosting CUWiP gatherings during the Jan. 13-15 event are Harvard University; McMaster University in Ontario, Canada; Montana State University; Princeton University; Rice University; University of Colorado Boulder; University of California Los Angeles; University of Wisconsin-Madison; and Wayne State University in Michigan.

National funding for CUWiP, now in its 11th year, comes from the National Science Foundation and the U.S. Department of Energy's Office of Science. Students traveling to Virginia Tech hail from Georgia, Maryland, North Carolina, South Carolina, Virginia, Tennessee, West Virginia, and Washington, D.C.

Written by Steven Mackay

VT News January 9, 2017

J. Mark Sowers Distinguished Lecture Series Brings Distinguished Speakers to Campus

Prof. Arthur B. McDonald (second from left) joins lecture series sponsor J. Mark Sowers (first from left) and his family.

The Physics Department and College of Science were treated to a series of distinguished lectures this year due to the generosity of Virginia Tech alumnus J. Mark Sowers. The J. Mark Sowers Distinguished Lecture Series in the College of Science at Virginia Tech enables the college to host a series of lectures designed to be a forum to exchange new and innovative ideas in scientific fields. Generously supported by J. Mark Sowers, this series provides opportunities for the university community and general public to interact with and learn from eminent scholars and industry experts with experience in academia, science, business, government, and medicine, among other fields. Mark has a special interest in physics, so four of the five lectures in the series had physicists as speakers. The distinguished visitors gave well attended public lectures and interacted with faculty and students through meetings and lunches with students.

J. Mark Sowers is a Richmond, Virginia-based businessman and developer and longtime supporter of the College of Science. The distinguished lecture series, which builds off a number of science-based symposiums held several years ago within the College of Science, is designed to serve as a forum to exchange new and innovative ideas in scientific fields, including physics, nanotechnology, and neuroscience. "I hope that people will be inspired by the lecture series and to bring attention to Virginia Tech and its brilliant researchers for the advancement of fundamental physics," said Sowers in explaining the idea of the series and funding for guest speakers to the College of Science. "I feel that we may be at the beginning of a new era of physics, a time where great things could happen. And I want to help encourage that, to help promote and bring awareness to those working on the cutting edge." Sowers said he has long been a fan of science, in particular physics, and funding the lecture series is an effort to share that love with others. "When I was in high school, I signed up for physics," said Sowers. "I had no idea what physics was. In fact, I thought it was civics or something like that and wasn't very excited about it. But after the first day, I knew this was my passion. It was as if physics defined me."

The four physics related lectures were:

Prof. David H. Reitze, physicist and executive director of the Laser Interferometer Gravitational-Wave Observatory Project at Cal Tech, spoke on February 1, 2017 on "LIGO Opens a Window onto the Universe." Through the LIGO project, Reitze and his large team of international scientists announced in spring 2016 that they recorded the signal of two black holes colliding. The detection is a blockbuster moment in science history that proves Einstein's century-old theory of relativity and the existence of gravitational waves — ripples in the space-time fabric that were up until now the stuff of science-fiction. The detection was named the 2016 Breakthrough of the Year by Science Magazine and won the Nobel Prize for its founders this past October. Reitze spoke about what makes gravitational waves so difficult to detect and, yet at the same time, such powerful and unique probes of the universe. Prior to the talk, Reitze said: "I will talk about how we made the detection and discuss how gravitational astronomy promises to change our understanding of the universe."

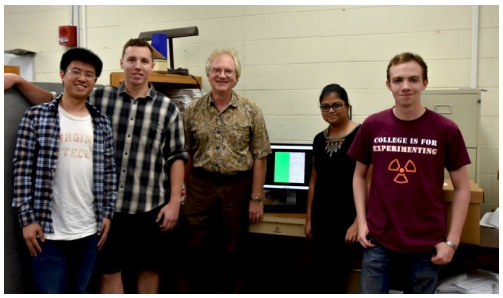
Prof. Naomi J. Halas, the Stanley C. Moore Professor in Electrical and Computer Engineering and a professor of biomedical engineering, chemistry, physics, and astronomy at Rice University, spoke on Feb. 22, 2017 on "Solar Steam Generation and Applications." Halas focused on solar steam generation and applications. In this discovery by Halas, a class of nanoparticles can convert a broad spectrum of sunlight to instantly vaporize water and create steam. This efficient light-generated process can impact solar energy harvesting, with the goal of producing steam directly for off-grid uses throughout the world. This discovery is part of solar-powered sterilization technology supported by the Bill & Melinda Gates Foundation. The heat and pressure created by the steam was sufficient to kill not only living microbes, but also viruses. "Sanitation technology isn't glamorous, but it's a matter of life and death for 2.5 billion people," Halas has said.

Prof. Arthur B. McDonald, professor emeritus of physics, engineering physics, and astronomy at Queen's University in Montreal and a 2015 Nobel Prize winner in physics, spoke on April 27, 2017 on "How Unusual: Going 1.2 Miles Underground to Study the Sun and the Space Between the Stars." He was co-winner of the 2015 Nobel Prize in physics for experiments that showed neutrinos can change "identities" and therefore have mass. The research took place at the SNO lab, 1.2 miles underground inside a nickel mine. McDonald proved neutrinos from the sun were not disappearing on their way to Earth and were captured with a different identity when arriving at SNO. The talk focused on SNO lab, one of the lowest radioactivity laboratories in the world, and addressed such questions as: How does the Sun burn? What are dark matter particles? What are the properties of neutrinos, one of the fundamental building blocks of nature? And how do these particles influence how our universe evolves?

Prof. Nigel D. Goldenfeld, holder of the Center for Advanced Study Professorship and Swanlund Endowed Chair at the University of Illinois at Urbana-Champaign, spoke on September 14, 2017 on "What Can Theoretical Physics Tell Us About the First One Billion Years of Life on Earth?" "Life on Earth is wonderfully diverse, with a multitude of life forms, structures, and evolutionary mechanisms," Goldenfeld said of his talk. "However, there are two aspects of life that are universal, shared by all known organisms. These are the genetic code, which governs how DNA is converted into the proteins making up your body, and the unexpected left-handedness of the amino acids in your body. One would expect that your amino acids were a mixture of left- and right-handed molecules, but none are right handed." Goldenfeld described how these universal aspects of biology can be understood as arising from evolution, but generalized to an era where genes, species and individuality had not yet emerged. He discussed to what extent one can find general principles of biology that can apply to all life in the universe, and what this would mean for the nascent field of astrobiology.

Videos of the David Reitze and Naomi Halas lectures are available at
https://www.science.vt.edu/sowers.html
Adapted from VT News articles written by Steven Mackay

Army research grant could employ physics theory to control epidemics, understand brain



Two Virginia Tech College of Science researchers are spearheading a $1.6 million U.S. Army Research grant with the idea that critical dynamics theory – that is, the effort to find order and control in the most chaotic and noisy patterns – can help stem the spread of disease during a potential epidemic or help doctors better understand the brain.

Uwe Tauber, a professor in the Department of Physics and director of the Center for Soft Matter and Biological Physics, and Michel Pleimling, also a professor of physics and director of the Academy of Integrated Science, are leading the effort. Seven graduate and two undergraduate students are working on the funded research project as well and will be joined by a post-doctorate researcher. The collaboration also involves P.S. Krishnaprasad, a professor with the Institute for Systems Research and the Department of Electrical and Computer Engineering at the University of Maryland, College Park.

The researchers will take the well-known theory for nonlinear stochastic dynamics of cooperative multicomponent systems – or critical dynamics – and develop new standards to understand and steer critical complex systems toward a desired and controllable outcome, even within highly fluctuating scenarios. In other words, the researchers will take what is now perceived as chaos and random noise – think bubbles in boiling water or static on a television – and then find patterns and establish control possibilities.

If patterns and control mechanisms can be found in such scenarios, the resulting concepts and mathematical tools could be used to track and control the spread of disease or civil unrest or better understand the workings of the brain's neurons, Tauber said. New theories also will impact the sciences from how physicists understand magnetism to how biologists see ecological systems.

"Our research team has begun to explore a wide range of potential applications that span from materials science, such as magnetism and surface growth, to synthetic biology, neuroscience, epidemiology, ecology, and social system dynamics," Tauber said of work done since the grant was awarded in March.

The theories that come from Tauber and Pleimling's work could find broad use in distinct areas. Think of the work as a Hollywood film set – say, the interior of a castle – that can be redressed to fit any genre: an action film, a historical drama, or a horror flick. The basic castle set remains the same, but finds unlimited uses as its adopted by different users for different purposes.

Tauber said the Army is investing in the atypical research because it values "fundamental research as the origin of many subsequent very useful applications." He added, "Understanding complex

cooperative systems is definitely a crucial challenge and would open many new applied research avenues as well."

Funding will be split among Virginia Tech and the University of Maryland, with three quarters of the $1.6 million going to Blacksburg and the remainder going to College Park.

Virginia Tech students working with Tauber and Pleimling include undergraduate researchers Alexandra Bosh, of Chesapeake, Virginia; and Ada Warren, of Daleville, Virginia; and graduate researchers Ahmadreza Azizi, of Tehran, Iran; Jacob Carroll, of Boyce, Virginia; Sheng Chen, of Liyang, Jiangsu, China; Ruslan Mukhamadiarov, of Sosnogorsk, Russia; Riya Nandi, of Kolkata, India; Shannon Serrao,, of Mumbai, India; and James Stidham, of Springfield, Illinois.

Written by Steven Mackay

VT News September 19, 2017

Welcome Our New Faculty Member

Satoru Emori has been appointed as an assistant professor with the Department of Physics, part of the College of Science.
Before arriving at Virginia Tech, Emori was a postdoctoral researcher at Stanford University. His research focuses on "spintronics" and magnetic thin films, or more specifically, nanometer-thick materials with robust spin-driven physics. Many of these phenomena are considered essential for next-generation computing and communications technologies.
His Spin-Magnetic Lab at Virginia Tech specializes in the development of new thin-film magnetic materials, as well as studying the spin transport and dynamics of tabletop and synchrotron techniques.

Emori earned a bachelor's degree from the University of California Irvine, and a doctoral degree from the Massachusetts Institute of Technology, both in materials science and engineering.

Written by Mari Botha

VT News November 30, 2017

Welcome our New Research Faculty

Jeffery Berryman joined the department in September 2017 and is working with Prof. Patrick Huber on neutrino theory. He received his Ph.D. from Northwestern University in June 2017 for his thesis "Neutrino Masses and Fermion Flavor," having worked with Prof. André de Gouvêa. He and his fiancée Molly met during their undergraduate studies at Notre Dame; the two will be getting married over Thanksgiving weekend of next year.

Fernando Calderon-Vargas, PostDoc at Virginia Tech with Edwin Barnes and Sophia Economou, June 2017 onwards. PhD (Physics - Quantum Information) from University of Maryland Baltimore County, MD, USA.

Stefano Dell'Oro joined the department in May 2017 and I'm working with Prof. T. O'Donnell on neutrinoless double beta decay with the CUORE experiment, a very large bolometric detector now in the initial phase of its data taking. Beside this activity, we are trying to setup a low-background counting facility at KURF, an underground facility located close to VT. I completed my PhD in Astroparticle Physics at the Gran Sasso Science Institute (L'Aquila, Italy) with a thesis on the commissioning of the CUORE cryogenic system, directly working on the experimental site at the Gran Sasso National Laboratories of INFN. Before moving to L'Aquila, I earned my Bachelor and Master degrees at the University on Milano-Bicocca.

Timothy Miller joined the department in August 2017 he is a Postdoc with Dr. Nahum Arav working on determining the physical characteristics of outflows from supermassive black holes and their impact on the host galaxy. May 2012-July 2017: PhD in Physics from the University of Oklahoma working on the chemical homogeneity of planetary nebulae and the physical properties of their stars. Advisor: Dr. Richard Henry August 2009-May 2012: Masters in Physics from the University of Oklahoma working on understanding the formation of the heliopause. Advisor: Dr. Richard Henry Hobbies: Woodworking, fishing, hunting, and gaming of all types (video, board, card, sports)

Paul Oelhmann

In Memoriam

Dr. Paul Zweifel, former University Distinguished Professor and member of the Department of Physics since 1968, passed away on February 12, 2017.

An obituary of Professor Zweifel was published in the August 2017 print edition of Physics Today. An online version is available at physicstoday.scitation.org/doi/10.1063/PT.3.3671

In short...

Prof. Uwe C. Tauber joins the Editorial Board of The Physical Review E.

Prof. Michel Pleimling is serving in 2017 as Chair of the Southeastern Section of the American Physical Society.

Physics Department shares 2016 University Exemplary Department Award.

Prof. Royce Zia co-organizes a conference in Germany on climate fluctuations and non-equilibrium statistical mechanics.

Prof. Djordje Minic co-organized a workshop at the Simons Center for Geometry and Physics on applied Newton-Cartan geometry.

Professors Uwe Tauber and ***Michel Pleimling*** receive $ 1.6M new research funding from the U.S. Army Research Office.

Prof. Michel Pleimling is the first recipient of the Dr. Carroll B. Shannon Excellence in Teaching Award, the preeminent College of Science teaching award for faculty that have an established history of teaching excellence.

Prof. Giti Khodaparast receives $1.2M in research funding for a multi-university grant from the U.S. Air Force Office of Scientific Research for "Nonlinear and Terahertz Studies of Electro-Optic and Magneto-Electric Materials".

Prof. Lara Anderson has been appointed as the Luther and Alice Hamlett Junior Faculty Fellow.

Professors Lara Anderson and ***James Gray*** organized the String Pheno 2017 conference held at Virginia Tech in July

Student News

Applause, Applause!

Physics major ***Stephen Loffert*** is a one of the recipients of an Army ROTC scholarship.

Graduate student ***Jacob Carroll*** shares best short talk award at the 2017 Molecular Biophysics symposium.

Lara Anderson and graduate student ***He Feng*** publish in special Emerging Talents issue of Journal of Physics A.

Congratulations to our Society of Physics Students chapter (advisor Alma Robinson and 2016-17 President Brian Hammack) for being named a Distinguished SPS Chapter for 2016-17.

Awards Day

On Friday, April 14, 2017, the department held its annual awards day luncheon. Awards and scholarships were presented to forty-three students in honor of their academic excellence in undergraduate and graduate studies.

Keynote speaker Nathan ("Nate") Johnson (class of 2005) spoke of his time as an undergraduate student at Virginia Tech and how that influenced his career as a Vice President, Wealth Management Advisor, and Senior Portfolio Advisor for Merrill Lynch Wealth Management.

Department of Physics Annual Fund

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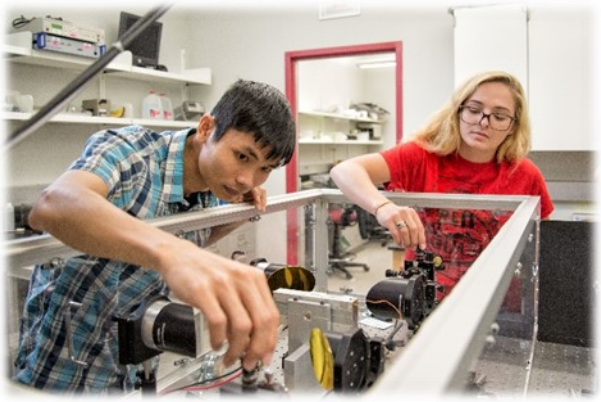

The **Department of Physics** continues to increase the quality and prominence of its research and educational programs. Our nationally and internationally recognized faculty, pursuing research in the areas of particle and nuclear physics, hard and soft condensed matter physics, biophysics and astrophysics while providing our students with a sound education that melds fundamental principles with current research, are helping Virginia Tech improve its standing as one of the top STEM schools in the country.

Your support is critical for our success. Contributions from our alumni, parents, and friends help our many deserving students, provide state-of-the-art facilities, expand research activities, and allow our students explore a wide array of career opportunities. Gifts made without restriction allow departmental leaders to respond to opportunities immediately and to allocate resources where they can have the greatest impact.

Every gift counts – no matter the size. Our goal this year is to **increase overall participation.** A gift to the Department of Physics is the clearest signal our alumni and friends can give to show their support of the great work of our faculty and increasing the quality of experience for our students. **When all of us give, our collective contribution makes a significant difference.**

When you receive your College of Science Annual Fund letter or phone call, please earmark your support for the **Department of Physics** Annual Fund. Simply make a notation on the gift card or let the caller know that you want to direct your donation to Physics. To make an immediate contribution, you may visit the university's website at givingto.vt.edu or contact the Office of Gift Accounting at (800) 533-1144

For more information or to learn about other ways to support the College of Science, please contact Wade Stokes, Assistant Dean of Advancement, at (540) 231-4033 or lwstokes@vt.edu.

We thank you in advance for your support!

Physics in Your Neighborhood!

Alumni Reunion – 2018 March Meeting of the APS in San Francisco, California (Time and Place TBD)

For more information, go to http://www.phys.vt.edu/events

Quanta 2017

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