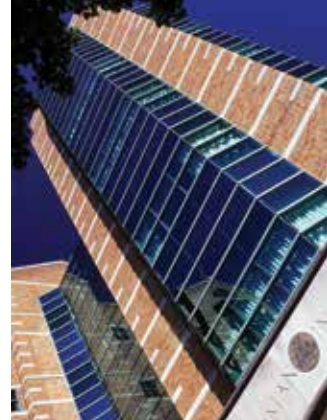




Fall 2017 • Issue 33

SYNERGY



BECKMAN INSTITUTE FOR ADVANCED SCIENCE AND TECHNOLOGY



TRAINING THE NEXT GENERATION OF RESEARCHERS

This past summer, 10 undergraduate students performed research at the forefront of advanced imaging and microscopy technologies with faculty and graduate student mentors. The “Discoveries in Imaging” Research Experience for Undergraduates also gave them a first-hand look at what it's like to be a graduate student. See page 3.

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SYNERGY is a publication of the Communications Office of the Beckman Institute for Advanced Science and Technology at the University of Illinois at Urbana-Champaign. Each issue highlights the people and science that make the institute one of the premier facilities for interdisciplinary research in the world.

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Beckman Institute for Advanced Science & Technology



ON THE COVER: During the 10-week "Discoveries in Bioimaging" Research Experience for Undergraduates, Cheri Fang, left, a first-year Ph.D. student in bioengineering, served as a graduate student mentor for Amanda Craine, a junior in biomedical engineering at Pennsylvania State University. See story, page 3.

From the Director ...

The Beckman Institute is about establishing connections and creating research synergy between our faculty and staff members, the University of Illinois, and the larger community. To this end, we have been looking at ways to reinvigorate the physical space at the Beckman Institute. We've been examining how our researchers use the building to interact and how we bring members of the campus and outside community into the institute.



Jeff Moore

Communication is one aspect of the dynamic interaction between those that call Beckman "home" and those that are interested in what we do here. We're looking at ways to improve our communication pathways, and are in the process of updating the Beckman website and examining other venues that communicate about the exciting projects and events that happen here.

Communication is a two-way street and we'd like input on the best ways for you to receive news about the institute. As we prepare for our 30th anniversary celebration, we'd like to keep you informed about upcoming events. We're interested in what you think is the best way to do that.

Do you follow us on Facebook (BeckmanInstitute) or Twitter (@BeckmanInst)? Are you subscribed to our publications listserv (go.illinois.edu/Beckman_Subscribe)? Do you have any comments about our outreach efforts and publications?

We'd love to uncover what information resonates with you and the best way to deliver it to you. If you have thoughts or suggestions, please email publications@beckman.illinois.edu.

Sincerely,

Jeff Moore, Director

Beckman Institute for Advanced Science and Technology



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Program Provides Undergrads with Research Experience, Professional Development

By Doris Dahl

This summer, 10 undergraduate students performed research at the forefront of advanced imaging and microscopy technologies through the “Discoveries in Bioimaging” Research Experience for Undergraduates (REU). Funded by the National Science Foundation, the 10-week program allowed the students to experience life as a graduate student.

“Our REU program is a wonderful opportunity to bring in some of the top undergraduate students in the U.S. and inspire them through bioimaging to pursue graduate degrees,” said Stephen Boppart, a professor of electrical and computer engineering and of bioengineering who also is co-chair of Beckman’s Integrative Imaging theme. Boppart is the principal investigator for the program. “This is the perfect opportunity to engage the next generation of scientists and engineers, particularly those from underrepresented groups,” he said.

“This is the perfect opportunity to engage the next generation of scientists and engineers, particularly those from underrepresented groups.”

—Stephen Boppart

Marina Marjanovic, the REU program coordinator and the associate director of the GSK Center for Optical Molecular Imaging, said the program, which receives more than 100 applicants each year, has three main goals.

“It’s about research and exposure to a different academic environment,” Marjanovic said. “It’s also about professional development because we offer them other types of training besides research.”

Professional Development

The program begins with a weeklong Bioimaging Bootcamp that provides safety information as well as foundational information on biology, imag-

ing, and microscopy through lectures, demonstrations, lab activities, and tours. Then, the students engage in intensive research projects in imaging and biological visualization, closely mentored by a faculty member and graduate student. The program has exceeded expectations and benefits everyone involved, according to Boppart.

“The (undergraduate) students have been excellent and incredibly dedicated to their research and to fully experiencing the graduate research lifestyle,” he said. “Their graduate mentors have gained a new sense of professional maturity as they shift from student to teacher, and the faculty mentors have seen their own research program advance as a result.”

Professional development also is a key part of the program. Several U of I REUs and similar campus programs often collaborate on activities for participants, and the Graduate College hosts professional development events for students as well. In addition, the students receive guidance in preparing for an oral and poster presentation at the campus’s Illinois Summer Research Symposium (ISRS).

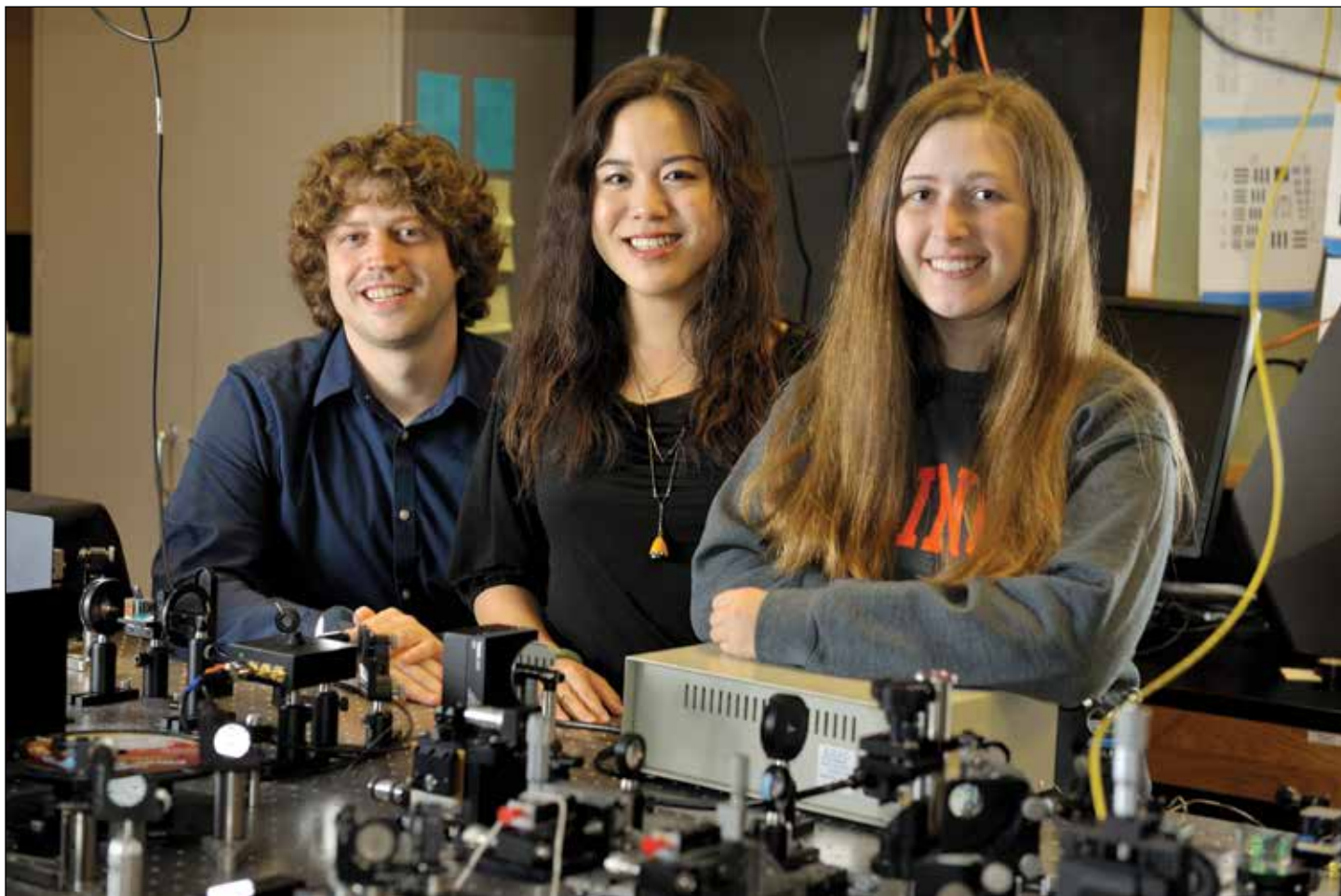
Students Reap Rewards

Participants are enthusiastic about the benefits of an REU.

“I didn’t know much about bioimaging or medical device research prior to this REU,” said Amanda Craine, who is now



Jamila Hedhli, left, a fourth-year Ph.D. student in bioengineering, and Than Huynh, a junior in bioengineering at Illinois, demonstrate equipment in Beckman’s Biomedical Imaging Center.



From left, Andrew Bower, a fifth-year Ph.D. student in electrical and computer engineering, and Joanne Li, a sixth-year Ph.D. student in bioengineering, mentored Janet Sorrells, a fifth-year senior studying biomedical engineering at the University of Rochester.

in her junior year in biomedical engineering at Pennsylvania State University. “Through different seminars, I have learned about many different aspects of imaging research and its direct impact on the medical field. I have also learned more about graduate school admissions, the milestones within a Ph.D. program, and how to prepare for graduate school.”

Craine has been working in the lab of Princess Imoukhuede, an assistant professor of bioengineering and member of the Bioimaging Science and Technology (BST) Group. Craine’s summer research focused on studying angiogenesis, the growth of new blood vessels from pre-existing vasculature.

Craine’s mentor Cheri Fang, a first-year Ph.D. student in bioengineering, is participating in the REU for the first time. “Amanda has been doing great in learning the techniques important to our

research,” Fang said. “We have worked on experimental techniques (cell culture, immunomagnetic cell isolation, flow cytometry), technical writing, critical thinking, and using analytical software.”

Than Huynh—the only Illinois student in the group—is now a junior in bioengineering. This summer, he worked in the lab of Wawrzyniec Dobrucki, an assistant professor of bioengineering and member of Beckman’s BST Group. Huynh previously conducted research with Dobrucki and his graduate mentor Jamila Hedhli, a fourth-year Ph.D. student in bioengineering who also was a mentor last year.

“I saw this REU program as an opportunity to not only continue our research with my undivided attention, but also as an opportunity to explore more of the campus itself and all the cool ‘toys’ the other labs have,” Huynh said. “Through this experience, I also hope to get a look into graduate student life here (at Illi-

nois) and to further build on the foundations of my developing research skills.”

His research project utilized PET-CT and ultrasound technology in addition to laser speckle contrast imaging to assess angiogenesis and its connection to the phenotype of different melanoma cell morphologies.

Javier de Jesus Astacio, now in his third year studying mechanical engineering at the University of Puerto Rico at Mayagüez, worked in the lab of Catherine Best, a research assistant professor of bioengineering.

“My goal is to provide a realistic world of research experience,” Best said. “I like the students to see the ups and downs of research, and to appreciate the process of science.”

She was impressed with Astacio’s progress in the program. “He has exceeded my expectations in every way,” she said.

“Javier is tenacious, has persevered through many technical challenges, thinks critically, and is a great communicator. With these traits, and a little guidance from Pati Cintora (his graduate student mentor), he successfully used spatial light interference microscopy (SLIM) to quantify mass, volume, and cell density maps from his 3D models of a mouse cerebellum.”

Leading by Example

Joanne Li, a sixth-year Ph.D. student in bioengineering, has served as the REU’s research team leader for three years and served as a graduate mentor for Janet Sorrells, a fifth-year senior studying biomedical engineering at the University of Rochester who is working in Boppart’s lab. Li was impressed with Sorrells’ achievements.

“She’s doing amazing and has totally exceeded my expectations,” Li said during the program. “Since both Andrew (Bower, a fifth-year Ph.D. student in electrical and computer engineering who also is a grad mentor for Sorrells) and I have taken the approach of being very hands-off with her, she usually works independently—and she’s getting lots of good data. Her independence plus this level of work quality is something I don’t often see from an undergraduate student.”



During the 10-week Research Experience for Undergraduates, Cheri Fang, left, a first-year Ph.D. student in bioengineering, served as a graduate student mentor for Amanda Craine, a junior in biomedical engineering at Pennsylvania State University.

As the research team leader, Li checks in with each student frequently, holding weekly meetings to make sure they are making progress, meeting deadlines, and also handling the stress of such an intense program.

“One of the purposes of this program is to let the students experience grad school at the U of I, so I share a lot of my experiences with the students—both good and bad—because at the end of the program, I want them to have a clear and realistic idea of what grad school is like and

whether it’s the path they want to take,” Li said.

Marjanovic is preparing an NSF proposal to renew the REU, which is in its final year of a three-year agreement. Andrew Smith, an assistant professor of bioengineering and co-PI for the program will serve as PI and Marjanovic as co-PI if the project is accepted; Boppart will continue as a faculty mentor.

Of the 12 students who have graduated since participating in the program during the first two years, nine are in graduate school or will enter this fall. Four are enrolled at Illinois. One additional student has deferred his admission and plans to attend Illinois.

“We hope to continue our involvement because of the success of the program in encouraging undergraduate students who are underrepresented in STEM graduate programs to attend graduate school,” Smith said. “Continuing also benefits (the Urbana campus) directly because the program serves as a unique experience for undergraduates from other campuses to become immersed in campus prior to applying for graduate school, which enhances our recruitment rate of top students.”



At right, Catherine Best, a research assistant professor of bioengineering, supervises students, including REU participant Javier de Jesus Astacio, center, who is in his third year in mechanical engineering at the University of Puerto Rico at Mayagüez, and Yujin Lee, an Illinois junior in bioengineering.

METRO Sniper Unit Benefits From Vis Lab Expertise

By Doris Dahl

Members of the sniper unit of the Champaign County Metropolitan Emergency Tactical Response Operations (METRO) gathered last month for an unconventional target practice that was captured on video.

And, that was the point.

"The METRO team is a multijurisdictional SWAT team that is activated in response to law enforcement situations that require special equipment, training, and a team approach in order to ensure the best resolution," said Officer Grant Briggs, of the U of I Police Department.

Travis Ross, the manager of Beckman's Visualization Laboratory (Vis Lab), which is part of the Imaging Technology Group, was asked to join the sniper unit at the Urbana shooting range to record high-speed video as three different types of ammunition penetrated various barriers, representing different scenarios the snipers might encounter.

"The round is traveling at such a high speed, it's hard to picture what's happening to it as it's traveling through the barrier," Briggs said. "The high-speed camera gives us the ability to see what happens to the different bullets, what happens to the barrier, and how much debris is created. The results will aid us in selecting the



Officer Grant Briggs, of the U of I Police Department and a member of the METRO sniper unit, fires a round at 100 yards from the target. "The high-speed camera gives us the ability to see what happens to the different bullets, what happens to the barrier, and how much debris is created," he said.

proper equipment. We can be called to respond to a vast range of situations and it is imperative we select the right tool for the job."

The Vis Lab was a perfect fit for the project and Ross was excited at the prospect of his first ballistics experiment.

"I had never done this before. I have always wanted to do ballistics but I just thought 'What campus unit is going to need ballistics?'" Ross said. "But I never thought the SWAT team would need Vis Lab services."

To assist Ross on his first ballistics project, John M. Huhn, the general manager of Motion Engineering Company, which

sold the camera to the Vis Lab, offered his services to help set up the Photron FASTCAM SA-Z ultra-high speed camera and make sure things went smoothly.

They fired several test rounds so that Ross and Huhn could make sure the camera was capturing the desired data and to make sure the images captured were clear enough to be useful.

"The sniper bullets were flying at around 2,675 feet-per-second and were shot from a distance of 100 yards so the time from rifle to target was only about 1/8th of a second," Ross said. "With that knowledge, we had to figure out how many frames per second was needed."

"We figured out we needed 25,000 frames per second (fps) to capture it minimally, so we doubled that and did 50,000 fps and were prepared to up it, if needed, but that seemed to be fine. And then we could adjust the shutter speed in order to capture more crisp detail."

"The longer the shutter is open, the blurrier a moving object will be," Ross said. "We want to stop that blur to ensure a crisp image. So something that fast we have to have a very fast shutter speed such as 10 or 15 nanoseconds."



Two frames from the high-speed video show the point of impact on the barrier. It was the first ballistics experiment for the Visualization Lab, but may not be the last as members of the sniper unit consider other uses for the technology to aid them in their jobs.

Each video clip was actually a fraction of a second in real time. The set up provided a three-foot-wide window for the camera with the material the snipers were shooting through in the middle. “With the camera shooting at 50,000 frames per second, by the time the bullet enters and exits the frame, there were only like 200 frames,” Ross said.

The team wanted to test several types of bullets to increase their accuracy. Although each bullet weighs about the same, the bullets had different covers or “jackets,” and the interior composition varied, which effects how each bullet expands and how it separates on impact.

From preliminary viewing of the videos on site after each shot, Ross felt confident from the reaction of the team that they were getting the desired data from the clips. Briggs confirmed the team’s satisfaction a few days later.

“I am happy with the preliminary results,” Briggs said. “I am going to compile the results into a presentation that I will share with the other members of our unit. We will analyze the results and decide if we need to modify our round selection depending on each type of barrier.”



Travis Ross, the manager of the Visualization Lab, adjusts the high-speed video camera he used to record the point-of-impact as three different types of ammunition penetrated various barriers. It was part of a project with the sniper unit of the Champaign County Metropolitan Emergency Tactical Response Operations (METRO).

“As snipers, it is essential that we have confidence in the round that is being fired,” Briggs said. “We have to be certain it will strike where we are aiming and deliver the terminal performance necessary to resolve the situation. Our work with the Visualization Lab will give us confidence that the right round is being utilized for the situation at hand.”

The project illustrated what Ross likes most about his job.

“Probably the thing I enjoy about my job is figuring out how to do some of these difficult tasks that no one else does,” Ross said. “I’m delivering a product that makes people’s lives easier in some way or so they can learn something or be inspired by it to learn more. Like today, they will probably come back and want to do more research because some of the results puzzled them. People learn things that they never thought possible.”

Briggs confirmed he is considering other applications for the high-speed video equipment.

“I can see potential for analyzing other weapons platforms—perhaps less lethal weapons, pistols, patrol rifles, and things like that.”

Members of the sniper unit participating in the project: Briggs, Officer David Dameron, Parkland Police Department; Officer Jared Hurley, Urbana Police Department; and Lt. Jason Norton, UPD.



Travis Ross, the manager of the Visualization Lab, consults with John M. Huhn to finetune the settings for the high-speed video camera. Huhn is the general manager of Motion Engineering Company, which sold the camera to the Vis Lab.

GSK Center Finding Early Success with Imaging Technique in Dermatological Studies

By Doris Dahl

Researchers at the Beckman Institute are investigating the efficacy of topical dermatological medications through noninvasive imaging technologies that track changes at the molecular level more quickly than previously possible.

The research represents a unique Beckman collaboration—a partnership between Beckman's Biophotonics Imaging Laboratory and the pharmaceutical company GSK, which created the GSK Center for Optical Molecular Imaging in 2016.

Perfect Match

GSK's global search for the right partner lead them to the Biophotonics Imaging Lab at the Beckman Institute and the lab's director, Stephen Boppart.

"Steve proposed a structure where we have GSK working side-by-side in the lab with postdocs and grad students working on the same project," said Zane Arp, U.S. lead for imaging technologies at GSK and co-director of the center. "They're

► Online Video:
bit.ly/BoppartVideo17

advancing the technology. We're advancing the applications. And the marriage of those two makes the sum greater than either part."

"Our advanced optical imaging techniques also enable new molecular, metabolic, structural, and functional imaging of cells and tissues, even in human subjects," said Boppart, who is co-chair of the Integrated Imaging theme and co-director of the GSK Center. "All of these aspects were directly relevant to what GSK was looking for in order to advance their drug discovery and development. There is a clear need to image drug distribution and efficacy at the molecular-cellular level in living tissues, and our techniques and technologies were a perfect fit."

Improving Efficacy

The techniques involve laser light that penetrates the skin about 200-500 microns. (The width of a single human

hair ranges from about 50-100 microns.) The light can actually penetrate completely through the skin—up to 10 centimeters—but it only provides valuable high-resolution imaging and feedback at about 200 microns in depth, according to Arp.

"Traditional imaging modalities such as MRI, x-ray, and CT typically measure morphological (or structural) changes," Arp said. "We're looking more for the small changes, the chemical-level changes that occur before you ever see that morphological change."

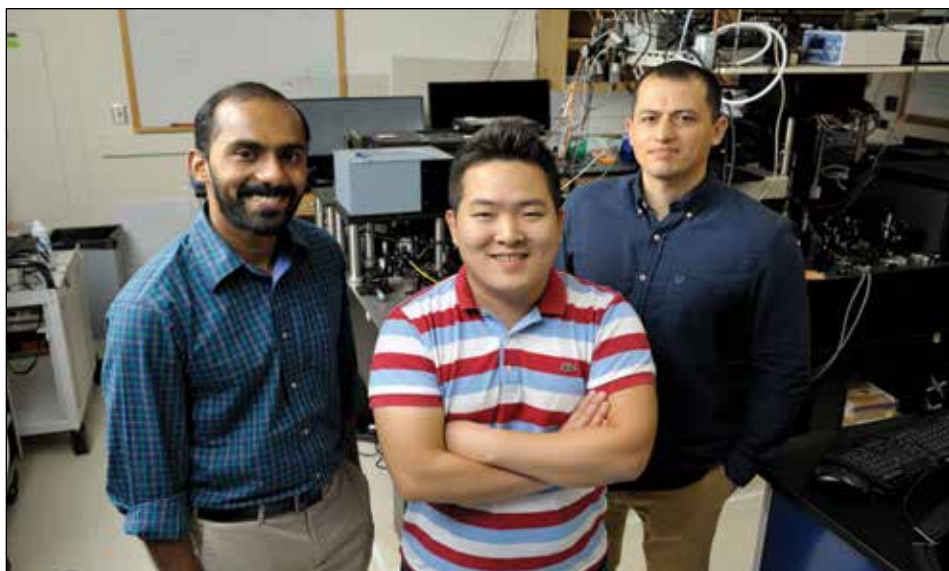
Detecting how medications work at the molecular-cellular level can save time and money.

The new optical imaging techniques allow researchers to see what targets the medication is hitting in a variety of different systems including cells, animals, and humans. This allows vertical translation of methods from these systems into clinical work, such as dermatology. In dermatology, the techniques can be used to determine how long the drug stays on the skin, the dosing regimen, and drug-target interaction. Skin is the body's natural protective layer so figuring out how much medication—if any—is penetrating the skin can be problematic.

"Most dermal drugs fail because they don't manage to get through the stratum corneum (the first layer of skin)," said Aneesh Alex, who is a GSK employee and a postdoctoral fellow in the center.

"As a drug development company, one of the critical aspects of our dermatologic drugs is how we defeat the barrier so that we're getting our medicine where it needs to go in the patient," Arp said.

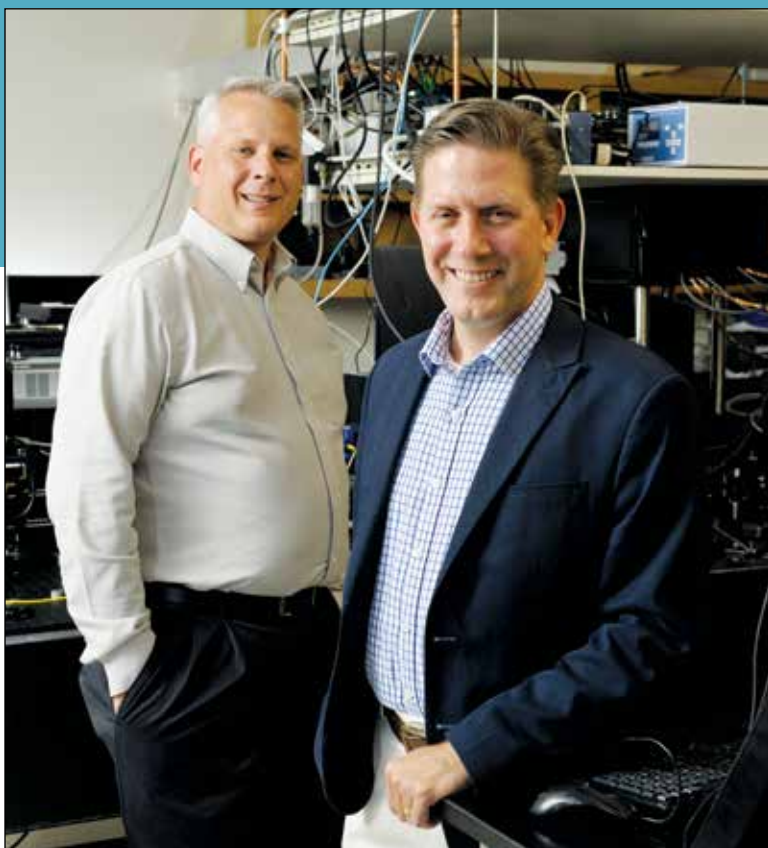
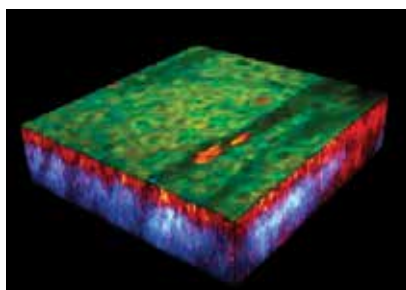
"If you get too much penetration too quickly, you'll just wash it out into your



Three GSK Postdoctoral Fellows—from left, Aneesh Alex, Jang Hyuk Lee, and Jose Rico-Jimenez—assist with research at the GSK Center for Molecular Optical Imaging based at the Beckman Institute.

Top right, the laser light is applied to a small area of skin, providing high-resolution imaging and feedback below the skin's surface. The technique assists with determining medication penetration, how long it stays on the skin, the dosing regimen, and drug-target interaction.

Bottom right, a 3D image of the scanned tissue is shown.



Co-directors for the GSK Center for Optical Molecular Imaging are Zane Arp, left, U.S. lead for imaging technologies at GSK, and Stephen Boppart, a professor of electrical and computer engineering and of bioengineering, and co-chair of the Integrated Imaging theme.

bloodstream,” he explained. “If you get too little penetration then you don’t see any effect. We also have to prove that the drugs hit the primary target the hardest. That’s where we get the most efficacy. It’s an art actually.”

Another benefit of the new platform of technologies is that they allow researchers to observe changes at the cellular level without tagging the medication applied with a dye, which can impact the test results.

Getting Results

The center has three to four projects in progress, and researchers have completed nearly half-a-dozen studies with several in publication.

The noninvasive techniques also allow the center to do its dermatological research on healthy human subjects as well as animal models.

“The other beauty of this is that we can do what we call an optical biopsy

because it eliminates the need for a true biopsy, where you need to extract a tissue sample,” Arp said.

The center also benefits from additional services and facilities at the institute.

“Another advantage is the facilities at Beckman, including the Microscopy Suite and other imaging facilities,” Alex said. “In the future, we are also planning to go beyond the optical capabilities so we want to make use of the MRI and PET capabilities that we have here. And I think that is something unique about Beckman. We have all the resources here under one roof. I think that is one of the main reasons GSK wanted to come here. Not a lot of places have these kinds of resources in one location.”

And even though it’s early, the center is seeing results and impacting decisions at GSK that will improve patient health care.

“Being able to see our drugs have an action at the earliest possible time point improves safety, improves the efficacy, and improves our knowledge base,” Arp said.

Alex also touted the benefits to the students involved in the research.

“I think by being able to be a post-doc here, I am getting the best of both worlds,” he said. “Because I see the industrial aspect and also the academic aspect, it’s really a unique development opportunity.”

“We are confident that we are on the right track, and that we have a very unique academic-industry partnership that is demonstrating early success,” Boppart said. “I believe it is important to continue this work because of the significant impact it can have, not only on drug development, but also ultimately on patient health and health care.”

GSK Center, continued on page 12

Mohaghegh Promotes Illinois' Leadership in Socio-technical Risk Analysis

By Doris Dahl & Justin Pence

The disaster at the Fukushima Daiichi Power Plant in Japan and the catastrophic Macondo oil spill in the Gulf of Mexico are bitter reminders of the critical need to create innovative scientific solutions for risk management, risk-informed decision making, and regulation. Zahra Mohaghegh, an assistant professor of nuclear, plasma, and radiological engineering (NPRE) and a member of the Organizational Intelligence and Computational Social Science Group, is helping position Illinois to become a global leader in socio-technical risk analysis.

Mohaghegh's goal is clear. "At Illinois, we want to develop the research and educational infrastructure that will help solve the most challenging risk and safety issues of industries," Mohaghegh said. To meet this goal, she is advancing probabilistic risk assessment (PRA).

PRA is the leading methodology for estimating the systematic risk for high-consequence industries and is a constantly changing technology that can meet the demands and challenges of complex socio-technical systems and processes. "Next-generation leaders must begin to think differently, using risk-informed solutions to initiate safe, resilient, sustainable, and socially responsible technological advancements to usher in an era void of technological accidents," Mohaghegh said.

Since its inception at the Massachusetts Institute of Technology, PRA is now one of the key pillars of the risk-informed



Zahra Mohaghegh is helping position Illinois to become a global leader in socio-technical risk analysis. She established the Socio-Technical Risk Analysis (SoTeRiA) Laboratory, where a multidisciplinary team of students, researchers, and industry professionals are advancing probabilistic risk assessment.

regulatory framework for the Nuclear Regulatory Commission. Other government agencies, including the Department of Energy (DOE), the Federal Aviation Administration, the National Aeronautics and Space Administration, the Department of Defense, the Environmental Protection Agency, the Food and Drug Administration, and the Department of Transportation, also have begun to adopt PRA for decision making and policy setting.

A concurrent trend is the expansion of PRA research and educational programs

at an increasing number of universities in the U.S. and abroad.

After completing her postdoctoral research appointment in 2011 at the Center for Risk and Reliability at the University of Maryland, Mohaghegh created a risk management consulting company in Boston. She made the move to academia in 2013 to fulfill her desire to teach and to interact with students through research.

"Although building a new area has its challenges, the criticality of the topic in high-consequence industries and the societal benefits of its applications will enable Illinois students with highly competitive skillsets to fill the growing demand for risk analysts," Mohaghegh said. "I believe that the collaborative research environment of Illinois will give me the opportunity to make this university a global leader in socio-technical risk analysis."

She has diligently worked toward this goal—establishing the Socio-Technical Risk Analysis (SoTeRiA) Laboratory, where

a multidisciplinary team of students, researchers, and industry professionals are advancing PRA with scientific innovations in two key areas: spatio-temporal causal modeling of social and physical failure mechanisms in PRA, and the fusion of big data analytics with PRA.

When Mohaghegh joined the NPRE faculty, she transferred a large-scale industry research project sponsored by the South Texas Project Nuclear Operating Company to Illinois. During the last four years, Mohaghegh and her

Mohaghegh, continued on page 12

Beckman Postdoc Receives First Place in 'Science as Art' Competition

By Maeve Reilly

Mostafa Yourdkhani, a postdoctoral research associate in the Autonomous Materials Systems (AMS) Group, recently received first place in the "Science as Art" contest sponsored by the Materials Research Society.

The image, taken with a scanning electron microscope (SEM) in the Microscopy Suite at the Beckman Institute, represents the cross-section of a polynuclear microcapsule embedded in an epoxy resin. From more than 100 entries, the image was chosen as one of the top three first-place winners.

The microcapsule is an example of the self-regulating material that is the signature work of the AMS Group. In this case, the material can be used in dental restorations, such as dental fillings.

"Several years ago we were approached by the National Institutes of Health National Institute of Dental and Craniofacial Research (NIDCR) about developing novel dental materials drawing from our original work on self-healing polymers," said Scott White, a professor of aerospace engineering and member of the AMS Group. "Through that initiative we made contact with a group at the University



The award-winning image, taken with a scanning electron microscope (SEM) in the Microscopy Suite at the Beckman Institute, represents the cross-section of a polynuclear microcapsule embedded in an epoxy resin.

of Illinois at Chicago lead by Dr. Ana Bedran-Russo and began a long-term collaboration on innovative dental resins that prolong the life of dental restorations."

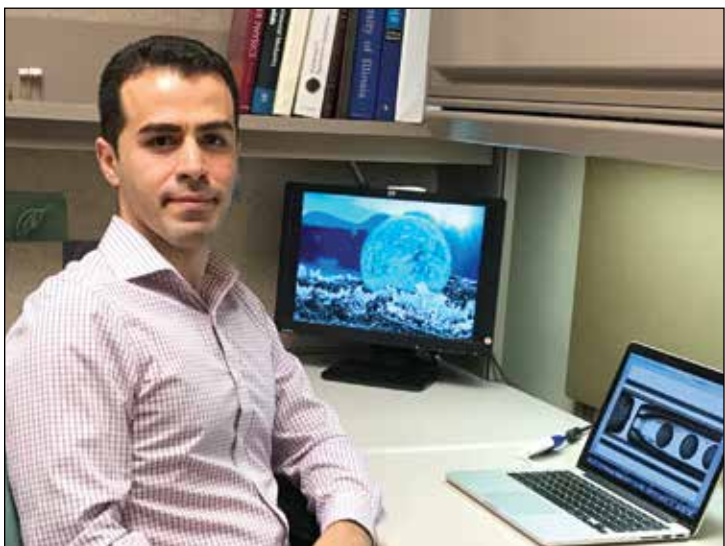
Bedran-Russo, from UIC's College of Dentistry, has worked on various natural extracts, such as grape seed extract and

tannic acid, to enhance the binding between teeth and filling material in order to construct long-lasting composite dental fillings. In clinical settings, however, the natural materials can be problematic: Applying all the extract at once may limit the length of time that the binding will last, and the extracts can cause adverse chemical reactions with the binding material.

The ideal solution is to release the natural extracts into the binding slowly over time.

"We were looking for ways to develop sustained and controlled release of the bioactives we isolated from plants so we could accelerate clinical implementation," Bedran-Russo said. So she reached out to White, seeking expertise in creating such a method. A NIDCR supplement allowed the creation of a collaborative team.

Yourdkhani, continued on next page



Mostafa Yourdkhani, a postdoctoral research associate in the Autonomous Materials Systems Group, received first place in the "Science as Art" contest sponsored by the Materials Research Society.

Mohaghegh, from page 10

graduate students have been developing an integrated risk methodology for the resolution of a 20-year longstanding safety issue in the nuclear industry, the Generic Safety Issue 191, which is related to the performance of the emergency core cooling system following a loss of coolant accident.

Mohaghegh became affiliated with the Beckman Institute in 2014, and the collaborative environment has helped her further her research in the field. As a Beckman faculty member, Mohaghegh has initiated collaborations with other Beckman groups, proposing new areas of discovery on the topics such as fire PRA, risk-informed emergency response, health care risk analysis, and monetary value of risk analysis, which assists companies and organizations to make decisions that not only promote safety but also helps their profitability.

In 2015, Mohaghegh became the principal investigator (PI) of a five-year National Science Foundation (NSF) grant to quantify organizational factors using big data analytics in PRA, and in 2017, she became the PI for a three-year DOE grant for enterprise risk management to promote the sustainability of the U.S. nuclear fleet.

With recent support from the College of Engineering, Mohaghegh is establishing the SoTeRiA Industry Affiliates Program (IAP), the first program in academia that works with industry for risk analysis and offers the latest research methods for real-time risk detection, monitoring, mitigation, and risk management with big data applications, while providing risk-analysis training. The SoTeRiA Laboratory has initiated collaborations with national and international research institutions and plans to expand risk

analysis collaborations through the program to develop tailor-made solutions for high-risk operations around the world. Industry members will work with the SoTeRiA IAP team to build specialized tools for solving their most challenging problems, while developing training series that fit their business needs.

“Risk analysis will be advanced by creative, scientific, and multidisciplinary students who have the interest and support to explore and study courses among diverse engineering and non-engineering departments,” Mohaghegh said. “The Beckman Institute embodies this model and it is through this style that a university can enable the nonlinear cross-disciplinary thinking needed to analyze the risks emerging at the interface of social and technical systems.”

GSK Center, from page 9

“We’re very pleased with the progress being made,” Arp said. “We have had senior managers come out here who are extremely pleased with the type of work we’re doing and the fact that we’re getting value out of cutting-edge capabilities five to 10 years before the techniques are commercially available is a big deal.”

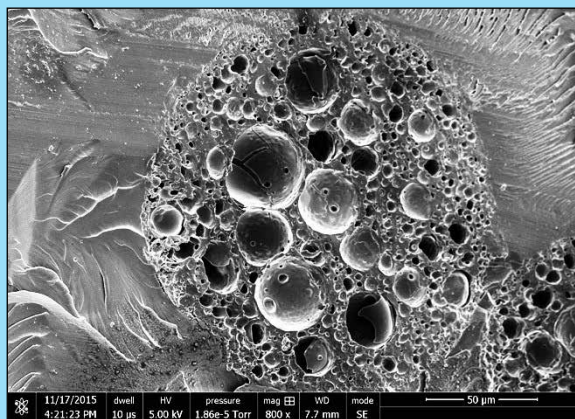
The center also is helping to drive the future of technology. For one, reducing the size of the equipment in order to help diagnose and treat individual patients is a possible long-range goal.

“We expect that we will start seeing biomarkers that are specific to individual patients or patient populations,” Arp said. “But I would say that using these technologies to differentiate patient populations for personalized medicine is a larger goal for us at some point. That’s something we see out in the future.”

Yourdkhani, from page 11

Working with White, Yourdkhani encapsulated the extracts in polymer microcapsules to protect them from the composite resin monomers. The capsule used in the award-winning image was about 200 microns large, but the capsules can be as small as 3 to 5 microns, perfect for dental materials. A recent paper in *Dental Materials* outlines the process (visit bit.ly/DentalMaterials_June2017)

The shell of the capsules is a biodegradable and biocompatible polymer, which allows for the gradual degradation of the shell polymer, and slow release of the bioactive extract. The polynuclear structure of the capsules allows for continuous release of the extracts as the capsules degrade from



Polynuclear microcapsule

the outermost layers toward the inner layers.

“That material will work longer, for less cost, less loss of dental tooth structure, and fewer visits to the dentist,” Yourdkhani said.

The research is sponsored by the National Institutes of Health. Mina Rezaeian, a graphic designer, helped with the final design of the artwork.

Memorial Symposium Honors Life, Career of Klaus Schulten



Klaus Schulten

More than 125 scholars and students gathered at the Klaus Schulten Memorial Symposium Nov. 7-9 at the Beckman Institute to honor the life and career of a leader in computational biophysics. Schulten (1947-2016) was a physics professor and faculty affiliate at the Beckman Institute.

Among more than 30 speakers, which included former students and colleagues from around the world, were Schulten's widow, Zaida "Zan" Luthey-Schulten, an Illinois chemistry professor; Nobel Prize winner Anthony Leggett; Beckman Founding Director Theodore "Ted" Brown; and current and former members of the Theoretical and Computational Biophysics (TCB) Group that Schulten founded in 1989, the year Beckman opened.



Theodore "Ted" Brown, the founding director of the Beckman Institute, remembers when Klaus Schulten founded the Theoretical and Computational Biophysics Group in 1989, the year Beckman opened. Brown is shown here with Zaida "Zan" Luthey-Schulten, who also is a TCBG member.



Sir Anthony Leggett gave closing remarks on the second day of the conference. Leggett, a professor of physics who also won the Nobel Prize in 2003, lives next door to the Schulten house.



Emad Tajkhorshid, a professor of biochemistry and group leader of TCBG, spoke at the symposium honoring his friend and longtime colleague. At the top of the slide, it says "First visit to TCBG, 1998." Tajkhorshid officially began his full-time Beckman career when he joined the group in 2000 as a postdoctoral researcher.

Kiessling Delivers Second Annual Beckman-Brown Lecture

Laura Kiessling, the Novartis Professor of Chemistry at the Massachusetts Institute of Technology, delivered the second Beckman-Brown Lecture on Interdisciplinary Science on Nov. 3 in the Beckman auditorium.

The annual lecture honors Arnold Beckman, the founder of the Institute, and Theodore "Ted" Brown, the founding director.

Kiessling's talk "Cell Surface Glycans as Cellular IDs," was followed by a reception in the atrium.



This year's speaker, Laura Kiessling, received a Beckman Young Investigator Award (1994-1996) at the Beckman Institute at the California Institute of Technology and said she met Arnold Beckman in person during her time at CalTech.



Joining Ted Brown, the Founding Director of the Beckman Institute, were Vivian Lau (left), the 2017 recipient of the Beckman-Brown Interdisciplinary Postdoctoral Fellowship, and Lydia Kisley the inaugural recipient of the award (2016).

Sen. Bennett Tours Beckman, Talks About Science Legislation

Sen. Scott Bennett (D-Champaign) spoke in the Beckman Institute Auditorium about working with scientists to craft legislation within the Illinois Senate. Prior to his July 13 talk, Bennett toured Beckman learning about research within the Autonomous Materials Systems Group and viewing the facilities of the Bioimaging Medical Center. The event was planned by the campus' Science Policy Group and co-sponsored by the Beckman Institute.



Sen. Scott Bennett tours labs of the Autonomous Materials Systems Group at the Beckman Institute. The group is known for its research on self-healing materials.



Brad Sutton, an associate professor of bioengineering and member of Beckman's Bioimaging Science and Technology Group, explains to Sen. Scott Bennett about the capabilities provided by the new Prisma MRI in the Biomedical Imaging Center.

Sen. Scott Bennett tours the Biomedical Imaging Center at the Beckman Institute. Iwona Dobrucki, a senior research scientist, explains about some of the scanning capabilities in the Molecular Imaging Lab (MIL).



The full talk is online: bit.ly/SenBennett-Video17

Mahadevan Delivers SmithGroup JJR Lecture

The April 21 SmithGroup JJR Lecture was presented by L. Mahadevan, England de Valpine Professor of Applied Mathematics, a professor of organismic and evolutionary biology and of physics at Harvard University. His talk, "Shape: Mathematics, Physics, Biology, and Engineering," took attendees on a vibrant tour from biological shapes to the mathematics of shape comparison to predictive theories, and even origami and map folding. The SmithGroup JJR (formerly Smith, Hinchman, and Grylls Associates, of Detroit) is the architectural firm that designed the Beckman Institute.



Harvard University's L. Mahadevan presented the SmithGroup JJR Lecture in the Beckman Institute auditorium on April 21.

From left, Tony LoBello, Rana Lee, and Andy Vazzano—from lecture sponsor SmithGroup JJR—join Beckman Institute Director Jeff Moore and Harvard Professor L. Mahadevan, who delivered this year's lecture.

2017 Beckman Student Award Recipients Announced

The Awards

Beckman Institute
Undergraduate Fellowship

Carle Neuroscience Institute
Undergraduate Research
Award

Cognition, Lifespan
Engagement, Aging, and
Resilience Awards

Erik Haferkamp
Memorial Award for
Undergraduate Research

Janssen Family Undergraduate
Research Award

Nadine Barrie Smith
Memorial Fellowship

Neurotechnology for Memory
and Cognition Awards

Organizational Intelligence
and Computational Social
Science Awards

Thomas and Margaret Huang
Award for Graduate Research



Nineteen students were named recipients of the 2017 Beckman Institute student awards. At a reception in their honor, award recipients gathered for a group photo with Jeff Moore, the director of the Beckman Institute, and Peter Schiffer, the vice chancellor for research. Pictured: (front row, from left) Moore, Kang Yong Loh, Anastassia Sorokina, Kevin Horecka, Hsiao-Ying Huang, Jungeun (Jenny) Won, Fatemeh Ostadhossein, and Schiffer. Back row, from left: Dongkwan Lee, Renato Azevedo, Yuan Bian, Michael Jorgenson, Jerome Davis, Ashley Lenhart, Ning Xu, Laura Pritschet, Lily Benig, and Taylor Jansen. Not pictured: Amit Das, Kathleen Murphy, and Natalia Wojnowski.

► For full bios of the awardees: bit.ly/BISStudentAwards17

2017 Beckman Institute Graduate Fellows Announced

The Beckman Institute Graduate Fellows program offers Illinois graduate students at the M.A., M.S., or Ph.D. level the opportunity to pursue interdisciplinary research at the institute.

The 2017 Beckman Institute Graduate Fellows are, from left, Shachi Mittal, a doctoral candidate in electrical and computer engineering (ECE) and member of the Biomedical Science and Technology (BST) Group; Hassaan Majeed, a doctoral student in bioengineering and member of BST; Zhikun Cai, a doctoral student in nuclear engineering and a member of the Computational Molecular Science Group; Matthew Moore, a doctoral student in psychology and a member of the Social and Emotional Dimensions of Well-being Group; Timothy Moneypenny, a doctoral candidate in materials chemistry and a member of the Autonomous Materials Systems Group; Andrew Bower, an ECE doctoral candidate and member of BST; and Nitya Sai Reddy Satyavolu, a doctoral student in chemistry and a member of the 3D Micro- and Nanosystems Group.



► For full bios of the awardees: bit.ly/BIGradFellows17



Honors & Awards

Aluru Named APS Fellow



Narayana Aluru, a professor of mechanical science and engineering and member of the Computational Multiscale Nanosystems Group, has been named a Fellow of

the American Physical Society (APS), an honor bestowed to no more than one half of one percent of the society's membership. He was selected by APS' Division on Computational Physics.

Bashir Honored for Leadership, to Receive BMES Lecture Award



Rashid Bashir, a professor of bioengineering and member of the 3D Micro- and Nanosystems Group, was one of four Illinois faculty members honored with a Campus Award

for Excellence in Faculty Leadership. The Office of the Provost sponsors the campus awards to recognize excellence in leadership for faculty members who distinguish themselves with their vision of the future and their efforts to aid others in shaping that future.

Bashir also was selected to receive the 2018 Robert A. Pritzker Distinguished Lecture Award, the Biomedical Engineering Society's (BMES) premier recognition for outstanding achievements and leadership in the science and practice of biomedical engineering.

Beshers Honored with Grad College Award



Sam Beshers, coordinator of the Neuroscience Program, was honored with the 2017 Graduate College Excellence Award for Graduate Contact. The award seeks to recognize

"those staff members whose service has enhanced the experiences of graduate students and/or has had a positive impact on the operations of the graduate program or department."

Boppart Named BMES Fellow



Stephen Boppart, a professor of electrical and computer engineering and of bioengineering, and a member of the Bioimaging Science and Technology Group, was honored as

a Fellow of the Biomedical Engineering Society at the society's annual meeting. According to the society's website, a fellow has "demonstrated exceptional achievements and has made significant contributions within the biomedical engineering field."

Chan Named 2017 Sloan Research Fellow



Jefferson Chan, an assistant professor of chemistry and member of the Bioimaging Science and Technology Group, was one of four Illinois professors named a 2017 Sloan

Research Fellow by the Alfred P. Sloan Foundation. According to the foundation, the awards "honor early career scholars whose achievements mark them as the next generation of scientific leaders."

Ewoldt Selected to Participate in NAE Symposium



Randy Ewoldt, an assistant professor of mechanical science and engineering and member of the Autonomous Materials Systems Group, was one of 82 young engineers

selected to participate in the National Academy of Engineering's 23rd annual U.S. Frontiers of Engineering symposium in September. He was one of three engineers invited from the U of I.

Griffin Part of iVenture Class



Autonomic Energy Solutions, created by **Anthony Griffin**, a graduate research assistant in the Autonomous Materials Systems Group, is one of 12 student ventures

named iVenture Accelerator startups to participate in the program's intensive 10-week summer curriculum. Griffin developed patented microcapsules that prevent fires in and extend the lives of batteries.

Gruev Receives 'Best Paper' Honors at IEEE Symposium



Viktor Gruev, an associate professor of electrical and computer engineering (ECE) and member of the Bioimaging Science and Technology Group, and Nimrod Missael

Garcia Hernandez, a visiting ECE scholar, received two awards for Best Paper at the IEEE International Symposium on Circuits and Systems: one in the Sensory Circuits and Systems track and one for Best Student Paper. Gruev is principal investigator for the research.

Hadley to Receive Award for Leadership, Dedication



Pierce Hadley, a junior in bioengineering and a member of the first class of Cancer Scholars, received the William R. Schowalter Award, given by the College of Engineering.

Hernandez-Burgos Receives Author Award



Beckman Institute Post-doctoral Fellow **Kenneth Hernandez-Burgos** and Illinois doctoral student Mark Burgess received the Norman Hackerman Young Author Award for

best paper published by young authors in the *Journal of the Electrochemical Society*. Both work with Joaquín Rodríguez-López, assistant professor of chemistry and member of the Nanoelectronics and Nanomaterials Group. They were recognized for their publication, "Scanning Electrochemical Microscopy and Hydrodynamic Voltammetry Investigation of Charge Transfer Mechanisms on Redox Active Polymers."

Huang Named Top 10 Most Influential Scholar



Thomas S. Huang, a research professor of electrical and computer engineering and a member of the Organizational Intelligence and Computational Social Science Group, was

recognized by AMiner—a free online service for academic social network analysis and mining—as a Top 10 Most Influential Scholar for his contributions to the field of computer vision.

Kong Named AIMBE Fellow



Hyunjoon Kong, a professor of chemical and biomolecular engineering and a member of the Bioimaging Science and Technology Group, was inducted into the American

Institute for Medical and Biological Engineering College of Fellows.

Beckman Institute Vision and Spirit Award Recognizes Bhargava



► **Online Video:**
bit.ly/Video-VisionSpiritAward17

Rohit Bhargava, left, Founder Professor of Engineering, a full-time faculty member in the Bioimaging Science and Technology Group, and the founding director of the Cancer Center, received the Beckman Institute Vision and Spirit Award during a ceremony April 10 (the birthday of founder Arnold Beckman). Bhargava is shown with Jeff Moore, the director of the Beckman Institute. The \$150,000 award recognizes a Beckman researcher who exemplifies Beckman's vision in establishing the institute, and who has contributed significantly to the mission of the institute.

Llano Named Goldberg Professorial Scholar



Dan Llano, an associate professor of molecular and integrative physiology and member of the Neurotechnology of Memory and Cognition Group, was appointed the Benjamin

R. and Elinor W. Bullock and Edwin E. and Jeanne Bullock Goldberg Professorial Scholar in the Department of Molecular and integrative Physiology in the School of Molecular and Cellular Biology.

Li Named IEEE Fellow



Xiuling Li, a professor of electrical and computer engineering and a member of the Nanoelectronics and Nanomaterials Group, was named a Fellow by the Institute of Electrical and

Electronics Engineers. Li was recognized for her contributions to semiconductor nanomaterials for electronic and photonic applications.

Madak-Erdogan Among Eight NCSA Faculty Fellowships



Zeynep Madak-Erdogan, a professor of food science and human nutrition and a member of the Bioimaging Science and Technology Group, is among eight Illinois

faculty members awarded 2017-2018 Faculty Fellowships by the National Center for Supercomputing Applications at Illinois. Her work will explore the association between the serum factors and demographic variables related to poor outcomes in African-American women with breast cancer.

Moore Elected to National Academy of Sciences



Jeff Moore, the director of the Beckman Institute, a professor of chemistry, and member of the Autonomous Materials Systems Group, is one of four Illinois professors elected to the National Academy of Sciences.

Pan Elected Fellow of American College of Cardiology



Dipanjan Pan, an assistant professor of bioengineering and member of the Bioimaging Science and Technology Group, was elected a 2018 Fellow of the American College

of Cardiology for his contributions to translational nanomedicine in cardiovascular science.

Parameswaran Receives IEEE TCDE Early Career Award

Aditya Parameswaran, an assistant professor of computer science and member of the Organizational Intelligence



and Computational Social Science Group, was named this year's recipient of the IEEE TCDE Early Career Award. The award honors an individual for their body of work in data engineering in the first five years after their Ph.D.

Sam Among 14 Illinois Students, Alumni Offered Fulbright Grants



Kimberly Sam, who earned a B.S. in molecular and cellular biology from Illinois in May 2017, was one of 14 Illinois students and alumni offered student Fulbright grants

to pursue international educational, research, and teaching experiences this coming year. Sam, a member of the Bioimaging Science and Technology Group, was awarded a Fulbright grant to conduct medical research in Ecuador. Sam plans to attend medical school to pursue an M.D./Ph.D.

Illinois IFP Places Second in ImageNet Challenge



For the second time in three years, a team from Illinois has placed high in the global ImageNet Large Scale Visual Recognition Challenge (ILSVRC 2017). **Honghui Shi**, a

Ph.D. student in electrical and computer engineering who works with the Organizational Intelligence and Computational Social Science Group, led a team that placed second in all four categories of object detection and tracking from video. Shi works in the lab of Thomas Huang.

Tajkhorshid Named to Endowed Chair in Biochemistry



Emad Tajkhorshid, a professor of biochemistry and member of the Theoretical and Computational Biophysics Group, has been named the J. Woodland Hastings Endowed Chair in Biochemistry in the College of Liberal Arts and

Sciences. He is a leader in developing and applying advanced computational techniques to understand proteins.

Four Beckman Faculty Receive Provost's Campus Award



Beck

Four Beckman researchers are among 12 faculty members honored with the Provost's 2017 Campus Distinguished Promotion Award, which recognizes extraordinary contributions in quality of work and overall achievement.



Ewoldt

They are: **Diane Beck**, an associate professor of psychology, Mechanisms of Cognitive Control Group; **Randy Ewoldt**, an assistant professor of mechanical science and engineering, Autonomous Materials Systems Group; **Prashant Jain**, an assistant professor of chemistry, Nanoelectronics and Nanomaterials Group; and **Brad Sutton**, an associate professor of bioengineering, Bioimaging Science and Technology Group.



Jain



Sutton

You Wins McGinnis Fellowship



Sixian You, a fourth-year doctoral student and a member of the Bioimaging Science and Technology Group, received the McGinnis Medical Innovation Graduate Fellowship in the Department of Bioengineering.

Zhang Receives Engineering Achievement Award



Yang Zhang, an assistant professor of nuclear, plasma, and radiological engineering and a member of the Autonomous Materials Systems Group, won the 2017 Landis

Young Member Engineering Achievement Award from the American Nuclear Society.

Zhuo Receives Postdoctoral Scholar Award



Yue Zhuo, a Beckman Postdoctoral Fellow, received a postdoctoral scholar award for a paper that was submitted to the annual Microscopy and Microanalysis Conference.

Beckman Researchers Receive Blue Waters Awards

Eight Beckman researchers were among the Illinois researchers awarded 3,697,000 node hours (NH) of time on the Blue Waters supercomputer by the National Center for Supercomputing Applications (NCSA) from spring 2017 proposals: **Aleksei Aksimentiev** and **Nancy Makri**, members of the Nanoelectronics and Nanomaterials Group; **Aaron Anderson** and **Narayana R. Aluru**, members of the Computational Multiscale Nanosystems Group; **Juan Perilla** and **Jodi Hadden**, members of the Theoretical and Computational Biophysics Group; and **Alex Cerjanic** and **Brad Sutton**, members of the Bioimaging Science and Technology Group.



Aksimentiev



Makri



Anderson



Aluru



Perilla



Hadden



Cerjanic



Sutton

Dell, Gruebele, and Murphy Are New CAS Faculty Members



Dell



Gruebele



Murphy

Three Beckman Institute researchers are among those recently appointed as permanent faculty members of the Center for Advanced Study: **Gary Dell**, a professor of psychology and a member of the Illinois Language and Literacy Initiative; **Martin Gruebele** and **Catherine Murphy**, professors of chemistry and members of the Nanoelectronics and Nanomaterials Group. The appointment is one of the highest forms of academic recognition the Urbana campus makes for outstanding scholarship.

Beckman Researchers Honored for Excellence in Teaching

Four Beckman Institute faculty members were among those honored April 26 at the campus's Celebration of Teaching Excellence awards reception.



DeThorne



Stumpf



Suarez

Laura DeThorne, an associate professor of speech and hearing science and a member of the Illinois Language and Literacy Initiative; **Rebecca Stumpf**, an associate professor of anthropology and a member of the Bioacoustics Research Laboratory; and **Andrew Suarez**, a professor of animal biology and a member of the Bioimaging Science and Technology Group, were among the faculty members awarded the Campus Award for Excellence in Undergraduate Teaching, which recognizes sustained excellence in and innovative approaches to undergraduate teaching and contributions beyond classroom instruction.

Appointments Announced at Carle Illinois College of Medicine

Beckman researchers are among the inaugural faculty members for the Carle Illinois College of Medicine. They include **Dolores Albarracin**, **Rashid Bashir**, **Marni Boppert**, **Stephen Boppert**, **Stephanie Ceman**, **Neal Cohen**, **Wawrzyniec Dobrucki**, **Manuel Hernandez**, **Graham Huesmann**, **Iwona Jasiuk**, **Amy Jaye Wagoner Johnson**, **Mark Johnson**, **Hyunjoon Kong**, **Dan Morrow**, **Michael Oelze**, **Gene**

Robinson, **Joanna Shisler**, **Brad Sutton**, **Yurii Vlasov**, **Karen C. White**, and **Brenda Anne Wilson**. In addition, **Bashir**, a professor of and the head of bioengineering and a member of the 3D Micro- and Nano-systems Group, has been appointed a permanent executive associate dean of the college. **King Li**, the inaugural dean of the college, is a member of the Bioimaging Science and Technology Group.

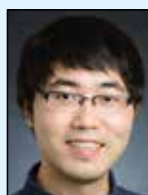


Robbennolt

Jennifer Robbennolt, a professor of law and member of the Social and Emotional Dimensions of Well-being Group, received the Campus Award for Excellence in Graduate and Professional Teaching, which recognizes sustained excellence and innovation in teaching and contributions to learning beyond classroom instruction.

Four Beckman Faculty Receive NSF CAREER Awards

Four Beckman faculty members received NSF CAREER Awards, which provide five years of monetary support.



Gao

Liang Gao, an assistant professor in electrical and computer engineering and member of the Bioimaging Science and Technology Group, received the award for his proposal on compressed fluorescence lifetime imaging microscopy.



Imoukhuede

Princess U II Imoukhuede, an assistant professor of bioengineering and a member of the Bioimaging Science and Technology Group, received the award for her proposal, "qBio+cBio=sBio; Identifying the role of cross-family signaling in angiogenesis."

Aditya Parameswaran, an assistant professor of computer science and mem-



Parameswaran

ber of the Organizational Intelligence and Computational Social Science Group, received the award for his proposal, "Advancing Open-Ended Crowdsourcing: The Next Frontier in Crowdsourced Data Management."



Zhu

Wenjuan Zhu, an assistant professor of electrical and computer engineering and a member of the Nanoelectronics and Nanomaterials Group, received the award for her proposal, "Transforming Electronic Devices Using Two-dimensional Materials and Ferroelectric Metal Oxides."

Benjamin, Stine-Morrow Appointed APA Journal Editors



Benjamin

Aaron Benjamin, a professor of psychology and member of the Mechanisms of Cognitive Control Group, and **Liz Stine-Morrow**, a professor of educational psychology and member of the Cognition, Lifespan Engagement, Aging, and Resilience Group, have been appointed editors of journals published by the American Psychological Association: *Journal of Experimental Psychology: Learning, Memory, and Cognition*, and *Psychology and Aging* respectively. The six-year terms begin in 2019.



Stine-Morrow



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