

SYNERGY



Issue 27 • Fall 2014

25

years of interdisciplinary research

BECKMAN INSTITUTE

FOR ADVANCED SCIENCE AND TECHNOLOGY

Identical Twins at Beckman



From left,
twins Cathy
Murphy and
Patty Jones.

Identical twins Patty Jones and Cathy Murphy have a few differences: One has long, wavy hair, the other's hair is shorter and straighter. One has lived on the West Coast, and the other in the Southeast. One is a chemist, and one is an engineer with a background in psychology.

However, genetic and professional similarities far outweigh their differences: First-generation college students at Illinois, Ph.D.s in their respective fields, and now colleagues at the Beckman Institute.

Jones is the associate director for research at the Beckman Institute. Murphy is a Beckman affiliate in the Nanoelectronics and Nanomaterials Group, and a professor of chemistry.

"In high school, we tried to make a more conscious effort to be different," said Murphy. "And maybe a little more in college too, but once we weren't actually in the same town, I think we ended up converging, you know, to a potential energy minimum. Which means that we're not too different."

Their divergent interests became evident in their undergraduate studies. Murphy found herself drawn to the physical sciences, in particular chemistry, while Jones developed more of an interest in the social sciences.

"I was always interested in nature and science going way back," Murphy said. "I liked chemistry. Physics I thought was boring, and in biology I had to kill things. In chemistry, you can grow colored

crystals, which is essentially what I still do today: I grow colored crystals."

Jones was more interested in studies of humans.

"I've always been interested in people and how people interact with the world and how people make decisions, so when I was thinking about what to major in in college, I was interested in psychology," said Jones.

The twins began their academic careers as undergraduates at the University of Illinois in 1982. Both sisters say that undergraduate research experiences were critical to their careers.

In Jones' case, she got involved freshman year through Psych 290, an independent study class that is still offered.

"My first experiment was to run subjects through a motor control experiment led by Professor Jack Adams," said Jones. "I did several of these classes all the way through my bachelor's career. I also got accepted into the psychology bachelor's honor thesis option, so I did an honor's thesis with Chris Wickens, who taught my introductory psych class.

"He taught the intro to experimental psychology class, which was general. Then he came into freshman orientation and talked about engineering psychology and that's when I decided that's what I wanted to do."

Murphy similarly began with undergraduate research in chemistry labs as a freshman.

"I started (with research) my second semester freshman year through the summer, through sophomore year, through junior year, all the way through until I graduated, with Tom Rauchfuss," said Murphy. "So I was involved in several chemical research projects—I could see how it all worked. And I thought, 'I can do this, I can go to grad school.' If I hadn't done undergraduate research, I don't know if it ever would've occurred to me to go to graduate school."

Murphy received two bachelor's degrees in 1986: one in chemistry and one in biochemistry. She then headed to the University of Wisconsin-Madison for graduate studies.

"When we told our parents that we were going to grad school, their response was: 'You mean you can't get a job?'" said Murphy. "And then, 'We're not paying for that!'"

Fortunately for their parents, graduate studies came with financial assistance. Murphy worked with Art Ellis at Madison. Her dissertation topic was rational tuning of the optical properties of semiconductor surfaces by molecular adsorption. As a postdoctoral fellow at California Institute of Technology she worked with Jackie Barton on electron transfer through DNA.

Her independent academic career began at the University of South Carolina in 1993, and she returned to Illinois in 2009. Her research pulls together all her previous experience since she looks at the interface of materials chemistry, inorganic chemistry, biophysical chemistry, and nanotechnology.

"My research program is all about inorganic nanoparticles," said Murphy. "We have to make these things, control their size, control their shape, which means in the case of metals, we can control their optical properties, meaning the colors of light they absorb, what they scatter, what they reflect, etc. And we do a lot of surface chemistry on them, so that gets back to my Ph.D. work a little bit.

"One thing I'm very interested in is in how these nanoparticles interface with

biological systems. We have been finding that when you bind proteins to your nanoparticle, your protein doesn't act like the same thing anymore. So just figuring a bound biological molecule is going to be 100 percent active (which is what many people assume for cancer targeting) is not a good assumption."

A main research question focuses on gold and silver nanorods, which can be "painted" with different chemical groups that allow the nanoparticle to be measured and followed throughout a system, similar to the way that green fluorescent protein allows biologists to follow biological functions in an organism.

However, the light emitted by green fluorescent proteins is often not bright enough to follow or can be extinguished. Murphy hopes that her research can create particles that can be identified at different wavelengths and could be used concurrently.

"That would enable completely artificial biomolecules with a core that you can follow easily, optically, in a biological matrix," said Murphy.

In this work, Murphy has partnered with researchers in the Bioimaging Science and Technology Group, including Rohit Bhargava and Stephen Boppart. She has also worked with Martin Gruebele from the Nanoelectronics and Nanomaterials Group.

Jones' graduate career began at Georgia Tech, where she received a master's and Ph.D. in industrial and systems engineering. After receiving her doctorate, she returned to Illinois as an assistant professor of industrial engineering in 1991.

"My lab was called Human-Computer Cooperative Problem Solving, or HiCCuPS," said Jones. "We studied different kinds of teams in complex, highly automated systems, so we did things with NASA, the Army, some stuff with the Navy. I had NSF grants that were more on the computer science side, looking at human-machines/human-technology interactions."



Cathy Murphy (left) and Patty Jones (right), circa 1965. Check out a video about the twins online: youtube.com/BeckmanInstitute

She became a Beckman affiliate in the Artificial Intelligence Group, and was involved in a grant from the Army Research Laboratory on advanced decision architectures. Led by Tom Huang and George McConkie, the grant had more than 20 professors involved on the project.

"It was the whole question of data fusion or management, we didn't call it big data at the time," said Jones. "How do you put this together to have a person make a good decision? It's still a big research question. And it was really fun to work on. I really enjoyed doing that kind of thing and it was different than what I could do by myself, in my home department."

In 2001, Jones resigned her tenured position at Illinois and moved to California to pursue a career in management at NASA Ames Research Center. She started as the deputy chief of the Human Factors Division and was eventually promoted to deputy director of Exploration Technology.

In 2011, Murphy, a Beckman affiliate by that time, sent Jones the announcement for the job of associate director for research at the Beckman Institute, a position newly created by Art Kramer, director of the Institute. Jones had worked with Kramer while at Illinois, as colleagues in the Engineering-Psychology Joint Program.

"Cathy sent me this email and I thought, this sounds like all the fun parts of my job at NASA," said Jones. "So I wrote to Art, and he encouraged me to apply, so I did."

Jones started as the associate director for research at the Beckman Institute in March 2012. Returning to Illinois not only provided Jones an opportunity to be near her sister, but it also allowed her

to contribute to the research culture at Beckman. Both sisters agree that other institutions don't provide the same support and culture that can be found here.

"At my former institutions, if you wanted to do anything, you had to do it all yourself," said Murphy. "If you wanted to make connections to other people, you had to go find them. The fact that Beckman is here means that if I want to be part of some group, I can. Also the seed grant program was a great thing for me, because it's real money that you can pay students with to try something collaborative."

As Jones assists Beckman faculty members in identifying research projects and maneuvering through policies and procedures, she also relishes the chance to be a part of a variety of projects. She is currently serving as project manager on the INSIGHT project, led by Aron Barbey, which aims to develop evidence-based tools and methods that may improve the quality of human judgment and reasoning in complex, real-world environments.

"I'm happy where I am," said Jones. "I think my interests have broadened, so it's much more fun to be a generalist at this point for me. I have my Beckman bookshelf, with books on cell biology, biomedical imaging, nanobiophotonics, memory, control theory, attention, climate change, cognitive neuroscience ... I like learning about all these different things, and I like helping other people be successful."

"That's the essential motivation of a teacher and a manager—helping other people succeed."

Fellowships Enable Clinical and Laboratory Research Experiences



Two new postdoctoral researchers at the Beckman Institute investigate issues related to the brain.

GILLIAN HAMILTON

Like any newcomer to college, Gillian Hamilton experienced the increased stress that comes with the transition from high school to college classes. In a research methods class during her first semester of her freshman year, Hamilton was asked to design an experiment, and she decided to write about what was affecting her the most: stress.

"I wanted to learn more about it, and the funny thing was, the T.A. in the class came up to me afterward and told me about a stress lab on campus. I looked into it, and ended up working in the lab until I graduated," Hamilton said.

"It was just amazing. I was looking at how stress—something everyone deals with—affects the brain so much. I knew that was the sort of field I wanted to study: how things we don't control impact our brain, and how we can alleviate or control that."

During her graduate studies in behavioral neuroscience at the University of Delaware, she became involved in studying the long-term adverse effects of fetal alcohol exposure and the potential benefits of behavioral therapies. As a 2014 Beckman Postdoctoral Fellow, she's continuing research in this area.

"I had seen how fetal alcohol exposure had affected people I knew. It's just something that's completely not their fault, they're born with it. It would be nice to come up with a way to help these people that's not just giving them more drugs," Hamilton said. "Instead, we're looking at more natural interventions—like running and environmental enrichment."

Hamilton came to Illinois in January 2013 with the intention of working as a postdoc with Justin Rhodes, a faculty member in the NeuroTech Group who researches the effects of exercise on brain function and

cognition using mice as a model organism. She has recently investigated how exercise interventions and subsequent brain neuron growth affect memory-related tasks in mice with fetal alcohol exposure.

"I developed this model in which mice are exposed to alcohol *in utero* during the third trimester equivalent, and we've found this leads to giant behavioral deficits after they're born," Hamilton said. "Once they're born, we give them 24-hour access to a running wheel over a prolonged period of time, and we see a recovery of these deficits and an increase in new neurons being formed in the brain."

Hamilton's work as a Postdoctoral Fellow stemmed from a collaboration with Beckman faculty member John Rogers.

"During one of the first seminars I went to as a postdoc, I saw John Rogers giving a talk about his microLEDs that, when attached to mice brains, were able to inhibit motor coordination: the mice would stop running when the researchers lit the microLED up in the brain," Hamilton said. "So I went to Justin and said, 'This is really cool, I would like to get involved with this.'"

Hamilton is now collaborating with postdoc Gunchul Shin in Rogers' lab along with a technician from Rhodes' lab, Daniel Miller, to use these microLEDs in her fetal alcohol exposure model.

"With John Rogers' technology, we can (use the microLEDs to) actually label those new neurons that are generated during the exercise intervention, and we can temporarily shut them off while the mice are exercising," Hamilton said. "Then we see if the mice still show a cognitive deficit or if they recover. It will really let us know if it's these newly generated neurons that are really playing a role in recovering from the effects of fetal alcohol exposure."

The microLED is a continually evolving prototype developed specifically for Hamilton's work, which she says is one of the perks of the collaborative atmosphere at Beckman.

"I'm working with students in both Justin's and John's labs in all types of disciplines, and we're all trying to solve these problems together," Hamilton said. "It's pretty cool."



As a 2014 Beckman Postdoctoral Fellow, Gillian Hamilton is investigating behavioral interventions that may alleviate symptoms of fetal alcohol exposure.

RACHAEL RUBIN

Working with a group of patients who have hippocampal amnesia was a compelling experience for Rachael Rubin, who spent her years as a Ph.D. student at the University of Illinois studying this unique form of memory loss. Even after Rubin visited the patients at the University of Iowa several times, they never remembered meeting Rubin, let alone her name or why she was visiting them.

Those with hippocampal amnesia have sustained damage restricted to the hippocampus, a part of the brain that forms memories. After the injury, patients can no longer form what is called declarative memories, or memories about new information, like what happened yesterday or meeting someone for the first time and learning his or her name.

Explained by patients as “always living in the moment,” hippocampal amnesia presents challenges as patients try to move forward with their lives.

“It does have a significant impact on their lives. That’s what I was really struck by,” Rubin said. “Some of them had families before their injury. Their roles as a parent had to be significantly reduced. There were certain things they just couldn’t do—putting together a schedule, remembering to-do lists. Others were being taken care of by their parents or lived in a nursing home. Their ability to live independently was really impacted.”

After closely observing this life-altering injury, Rubin became passionate about finding ways to improve the lives of those with brain injuries. After she finished her Ph.D. in cognitive neuroscience, she received the 2014 Carle Foundation Hospital–Beckman Institute Fellowship and decided to get involved in studies of patients with traumatic brain injury (TBI).

“I wanted to not only understand the brain and how it works, but also how brain injuries affect people’s lives. I was aware of how much great neuroscience research goes on at Illinois, but, at the same time, there was a lack of clinical or patient research. Through this fellowship with Carle, I thought we could do really great work by bringing them both together,” Rubin said.

With the fellowship, funded by Carle Foundation Hospital, scientists spend three years conducting independent, translational research in oncology or neuroscience. To kick-start her work in TBI, Rubin met with faculty and staff from both Beckman and Carle, who have all expressed interest in building a collaboration to study TBI.

“I’ve made it my mission to develop a patient registry of TBI patients,” Rubin said. “The area of TBI has overlap in my hippocampal amnesia work because memory impairment is a big part of TBI. TBI is caused by an external force—like an impact to the head—that causes the brain to hit against the skull and cause injury. Memory and executive function, or mental processes that help connect past experience with present action, are often impaired.”

Though traumatic brain injuries are classified as mild, moderate, and severe, even mild TBIs are still traumatic by definition, says Rubin. Brain function can be significantly impaired regardless of the severity, and it’s often difficult to tell how quickly patients will recover across the broad spectrum of severity.

“What is still not understood is that even in a particular category, let’s stay mild, some people will recover completely within 10 days and be functioning just fine, but then there’s other people who have more or less a similar injury, but will still be struggling to recover after months. That’s something that we don’t understand right now,” Rubin said.

TBIs are an all-too-common injury for many people: millions are affected every year, Rubin says.

“It could be someone in a car accident, an older person who has a fall, violence related, soldiers who have blast-related injuries, and of course athletes like those (sustaining head injuries) in football,” Rubin said. “It’s a common problem, but we still just don’t know enough about it.”

Rubin is working with faculty members at the Beckman Institute, including Neal Cohen, Aron Barbey, Art Kramer, Wendy Heller, and Kevin Jackson, as well as staff from the neurology, neurosurgery, physical medicine and rehabilitation, and emergency response (ER) departments at Carle to



With the Carle Foundation Hospital–Beckman Institute Fellowship, Rachael Rubin is planning to build a traumatic brain injury (TBI) patient registry and combine the clinical expertise of Carle with the research expertise of the Beckman Institute to further investigate TBIs.

recruit patients to be a part of the TBI registry, so Rubin and her collaborators can study how TBI affects a wide variety of people, across different spectrums of severity.

“We’re aiming to study the effects of TBI at different stages: from right when they come into the ER, after surgery if they need it, in rehabilitation, or if they’re following up on progress months after the injury,” said Rubin. “Once we have built up a database, we can start to investigate the nature of TBIs.”

Though she’s only just begun this fellowship in collaboration with Carle and the Beckman Institute, Rubin knows it’s a great fit for her.

“I’m really excited about bringing clinical and basic research together. I’ve always enjoyed neuroscience because it allows me to work with people and understand more about the brain and how it relates to behavior and quality of life,” Rubin said. “I want to help improve the quality of life for patients with TBI.”



The Art of Capturing Panoramic Photos with a Toy Helicopter

Camille Goudeseune has come up with a set of techniques to turn low-quality video into high-quality, high-resolution panorama still photos. Using a simple video camera attached to a relatively inexpensive and light quadcopter—costing around \$45—he can take his photography to new places.

Goudeseune started flying radio-controlled airplanes as a hobby shortly after starting his job at Beckman's Illinois Simulator Lab.

"At first, I put cameras in the airplanes, but some subjects that I wanted to photograph were inaccessible to airplanes or just outright dangerous," he said. "Helicopters at that time were still complicated and fragile. So when low-cost, low-maintenance quadrotor helicopters reached the market, I could finally dare to fly in such locations."

The main advantages of flying quadcopters, as they are commonly known, is that they pose a vastly lower risk of damage or injury and are inexpensive.

"If I lose control of the helicopter and it hits something, it's really no more dangerous than if a Frisbee hits it. It weighs less than a gerbil," he said. "If it gets damaged, it's cheap to replace, making it an attractive option to fly in otherwise unreachable places."

Goudeseune has mastered a set of techniques to acquire high-quality panoramas from quadcopters: maneuvering effectively, coping with wind, extracting still frames from the video recording, automatically culling frames to avoid motion parallax and motion blur, and suppressing artifacts due to the camera's poor quality.

"These techniques are all simple and inexpensive, as they should be for a toy," he writes in "Stitched Panoramas from Toy Airborne Video Cameras," a white paper detailing the process.

He waits to shoot a subject until the weather is acceptable and the wind is low in order to make the flying process as smooth as possible. For a photo Goudeseune took of the construction of the new Electrical and Computer Engineering (ECE) building (above), he stood atop the Micro and Nanotechnology Laboratory patio (just south of the ECE building), which gave him a height advantage so he could survey the entire building.

Two short flights by the quadcopter were all it took to get the video he needed of the ECE building. When the quadcopter is in the air, Goudeseune slowly pirouettes it to gather a panoramic view.

If I lose control of the helicopter and it hits something, it's really no more dangerous than if a Frisbee hits it. . . . If it gets damaged, it's cheap to replace, making it an attractive option to fly in otherwise unreachable places.

—Camille Goudeseune

Because of his interest in still photography, Goudeseune creates still photos from video to allow viewers the opportunity to examine landscapes in more detail than is possible in a video.

Once he captures the video, he uses image stitching software, like AutoStitch and Image Composite Editor, to compile clips of the video into an image. The video is just a series of JPEG still images, so he creates an algorithm that extracts those individual frames and stitches them together.



Camille Goudeseune, a computer systems analyst at the Beckman Institute's Illinois Simulator Lab, captured a panoramic photograph of the new Electrical and Computer Engineering (ECE) building (above) at the University of Illinois using only an inexpensive toy quadcopter equipped with a video camera and his flying ability. Left, another shot Goudeseune captured of the University of Illinois Arboretum.



Watch the video online

"Drone Photography: See What this Toy Quadcopter Can Do"



youtube.com/BeckmanInstitute

Additional steps involve removing or suppressing camera artifacts. In his paper, Goudeseune lists combinations of several coding commands, some in Ruby script, and details how to interact with programs like Adobe Premiere Pro and Adobe After Effects, to deal with artifacts like rolling shutter (warped and skewed images), moiré (undesired bands of hue and brightness), and motion blur.

"The video shoots 60 frames a second, and I generally stitch between 100 to 250 photos to make a panorama," Goudeseune said. "Though you can use programs to limit the number of undesired artifacts, it's helpful to be a skilled flier as well. When the helicopter is in the air, I try not to rotate it too quickly because I will get a very shaky image, or it will have color balance errors because the camera didn't have time to catch up with the sun exposure."

What started as a hobby has now become a research venture. Goudeseune is working with veterinary medicine researchers at the University of Illinois to build an automated helicopter with many of the same functionalities to take photos of cattle.

"My collaboration with Vet Med is aiming to infer the health of cows in feedlots based on spatial arrangement," Goudeseune said. "Cowboys are an endangered species, so we're looking at using this technology to fly over pens and identify when cows look sick, so the workers know which pens they should visit first and which pens are likely to have a disease outbreak."

This technique has applications to anyone who wants to fly where risk is a concern: over crowds, traffic, wildlife, etc.

"The quadcopters could use lightweight sensors other than cameras, like antennas, air quality sensors, chemical test strips, or even microphones," he said. "The range of potential applications is, of course, enormous, with the right implementation."

Goudeseune continues to use the quadcopter whenever and wherever he gets a chance, as he often carries it with him in his backpack.

"Its small size lets you grab unplanned shots. Last year, I took a panorama of Trenton, Ontario, because I had 10 minutes to spare waiting for the beer store to open," he said. "As the saying goes, the best camera is the one you have with you."

INVESTIGATING THE BASIS OF LIFE

Maria A. Bautista studies archaea and their viruses, and tries to find connections between the two in order to explain their evolutionary histories.

“Viruses are pretty awesome,” said Maria A. Bautista. Not the most common thing people say when talking about viruses, types of microbes responsible for the common cold, measles, mumps, influenza, and, more recently, Ebola.

Yet Bautista, a graduate student working in Illinois microbiology professor Rachel Whitaker’s lab, eagerly investigates the role viruses play in the very basis of life, and how they can sometimes help instead of harm.

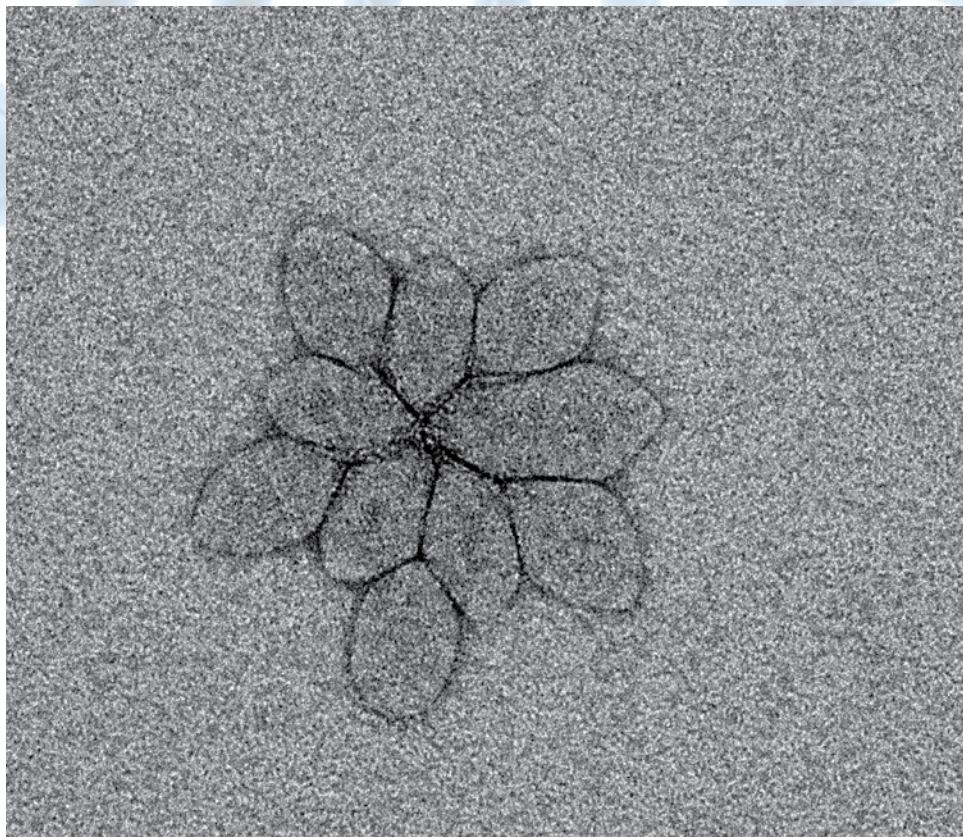
“It has been found that 8 percent of the human genome is of retroviral origin: somewhere along the evolutionary history, viruses integrated into the chromosome of the host cell, and stayed there to bring novel functions to the cells, which gives them an immediate advantage,” said Bautista.

“People overlook viruses as if they’re just disease, but they’re not just diseases. That 8 percent of the human genome is pretty important.”

Bautista, who’s working toward her Ph.D. in microbiology, has been studying viruses for the past several years, especially how they interact with archaea, one of the three domains of life.

Prior to the 1970s, scientists had lumped all living organisms into two main branches in the tree of life: bacteria and everything else that did not have a nucleus (prokaryotes) and plants and animals (eukaryotes). In 1977, however, Carl Woese, a professor at the University of Illinois, upended this assumption when he reported on archaea, single-cell microbes genetically distinct from bacteria and eukaryotes.

Woese had set out to map the evolutionary history of life by comparing the genetic sequences of protein-building structures in cells, known as ribosomes and ribosomal RNA. Along the way, he found that archaea, which had originally been grouped with bacteria as a prokaryote, had evolved separately from the other two groups.



This cluster of *Sulfolobus* spindle-shaped viruses was captured using the transmission electron microscope (TEM) in the Microscopy Suite at Beckman. These viruses are unique in the fact that they only infect members of the order *Sulfolobales*, a type of hyperthermophilic archaea that resides in the acidic hot springs in Yellowstone National Park and the Kamchatka Peninsula in Russia.

The new discovery added archaea as a third main branch of the evolutionary family tree.

He argued that understanding the evolution of microbes, which includes archaea, is central to understanding evolutionary biology. The secrets of the complexity of life today, he said, are written in the genomic sequences of microbes.

Woese, who died in 2012, advised Whitaker, who has devoted her research to understanding the biodiversity of microbes and how they impact ecological and evolutionary processes.

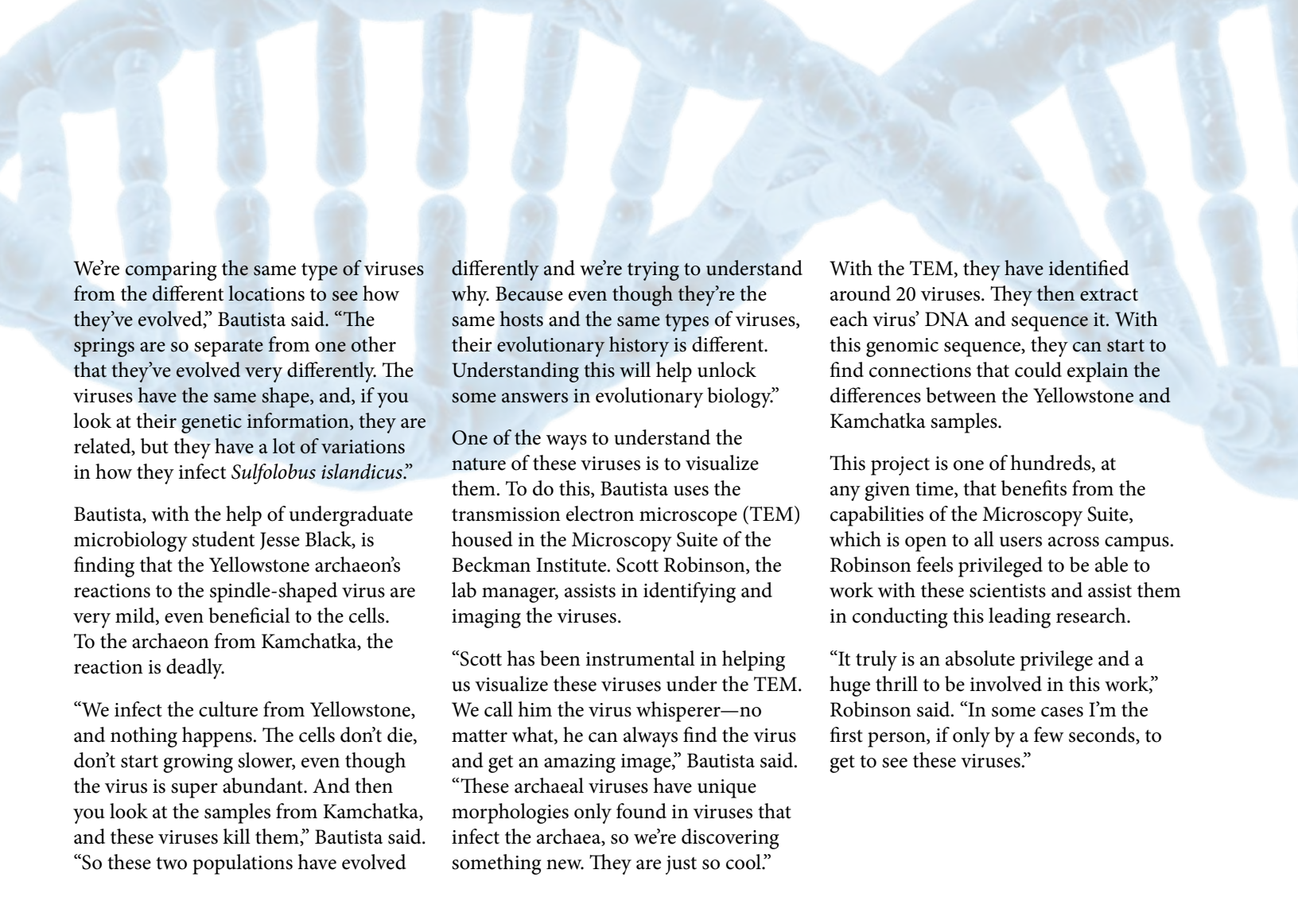
As Whitaker’s student, Bautista investigates the evolutionary history of a specific type of archaeon, *Sulfolobus islandicus*, and how viruses infect it. This archaeon lives

in acidic hot springs found in Yellowstone National Park and the Kamchatka Peninsula in Russia.

“The cool thing about *Sulfolobus islandicus* is that it lives in these acidic hot springs that are low complexity and completely isolated. The hot springs are removed from other influences or new species. So you can actually look at evolution in nature, which is really hard to do nowadays because people tend to tamper with natural evolution,” Bautista said.

The archaea that Bautista works on not only live in a unique environment, but they also host unique viruses.

“*Sulfolobus islandicus* has the weirdest-looking viruses ever discovered, like spindle-shaped ones or some with claws.



We're comparing the same type of viruses from the different locations to see how they've evolved," Bautista said. "The springs are so separate from one other that they've evolved very differently. The viruses have the same shape, and, if you look at their genetic information, they are related, but they have a lot of variations in how they infect *Sulfolobus islandicus*."

Bautista, with the help of undergraduate microbiology student Jesse Black, is finding that the Yellowstone archaeon's reactions to the spindle-shaped virus are very mild, even beneficial to the cells. To the archaeon from Kamchatka, the reaction is deadly.

"We infect the culture from Yellowstone, and nothing happens. The cells don't die, don't start growing slower, even though the virus is super abundant. And then you look at the samples from Kamchatka, and these viruses kill them," Bautista said. "So these two populations have evolved

differently and we're trying to understand why. Because even though they're the same hosts and the same types of viruses, their evolutionary history is different. Understanding this will help unlock some answers in evolutionary biology."

One of the ways to understand the nature of these viruses is to visualize them. To do this, Bautista uses the transmission electron microscope (TEM) housed in the Microscopy Suite of the Beckman Institute. Scott Robinson, the lab manager, assists in identifying and imaging the viruses.

"Scott has been instrumental in helping us visualize these viruses under the TEM. We call him the virus whisperer—no matter what, he can always find the virus and get an amazing image," Bautista said. "These archaeal viruses have unique morphologies only found in viruses that infect the archaea, so we're discovering something new. They are just so cool."

With the TEM, they have identified around 20 viruses. They then extract each virus' DNA and sequence it. With this genomic sequence, they can start to find connections that could explain the differences between the Yellowstone and Kamchatka samples.

This project is one of hundreds, at any given time, that benefits from the capabilities of the Microscopy Suite, which is open to all users across campus. Robinson feels privileged to be able to work with these scientists and assist them in conducting this leading research.

"It truly is an absolute privilege and a huge thrill to be involved in this work," Robinson said. "In some cases I'm the first person, if only by a few seconds, to get to see these viruses."

Recent Updates in the Imaging Technology Group

Over the past several months, the Microscopy Suite and the Visualization Lab, Beckman's two core facilities in the Imaging Technology Group, have undergone changes in terms of both physical space and capabilities.

In the Microscopy Suite, the fluorescence microscope has been completely updated with a new instrument, software, and computer; many of the instruments have had control computers upgraded; and two of the microCT systems have been given new computers, new RAID arrays, 360-degree capability, and load-cell capability, among other improvements. A new ultramicrotome has been delivered and set up in a completely remodeled space that also houses several other instruments and microscopes.

Additionally, a biosafety level 2 (BL-2) space is being created to facilitate live-cell imaging. Because some live cells may only be imaged under BL-2 conditions, this new space will house the cell and tissue culture facility

that incorporates two new systems: a FRET (fluorescence resonance energy transfer) microscope and BioSLIM (biological spatial light interference microscope) with TIRF (total internal reflectance fluorescence) imaging capability in opposition, permitting a novel form of correlative microscopy.

A photography suite, which features 20 MegaPixel DSLRs and a professional photo and video studio, was added to the Vis Lab in the past few months. It was moved to a larger room with higher ceilings in the Microscopy Suite to accommodate the equipment. The bigger space allows Vis Lab staff to be more flexible with how they work, and allows more freedom to meet the growing demand for photography services from their users. A 3D scanner was also added.

"We're truly a boutique service for our users," said Travis Ross, Vis Lab manager. "We're here to assist users in whatever they need to accomplish, and we will update and change our capabilities in order to meet their needs."

1989-2014 Celebrating 25 years

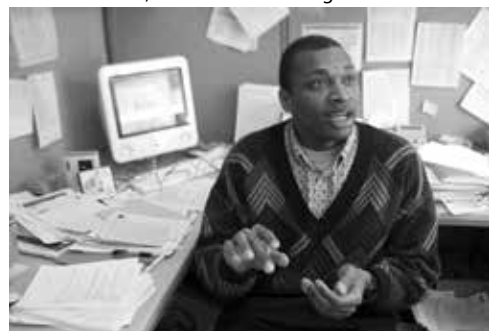
This year marks the 25th anniversary of the Beckman Institute. A symposium on Friday, October 10, celebrates the anniversary. Former Beckman Postdoctoral Fellows will give presentations. For more information, visit beckman.illinois.edu/events/anniversary.

A look at our history...

Original faculty members of the Beckman Institute who are still at Beckman:

- Narendra Ahuja
- Yoram Bresler
- Neal J. Cohen
- Gerald F. Dejong
- Gary S. Dell
- Martha L. Gillette
- Rhanor Gillette
- Thomas S. Huang
- Seth A. Hutchinson
- Douglas L. Jones
- Arthur F. Kramer
- Jean-Pierre Leburton
- Joseph W. Lyding
- Gregory A. Miller
- Umberto Ravaioli
- Brian H. Ross
- Klaus J. Schulten
- Stephen G. Sligar
- Kenneth S. Suslick

From left, Marc Taylor, Tracey Wszalek, Klaus Schulten, and Thomas Huang.



Civil Service and Academic Professionals who have worked at Beckman for 15 years or more:

- Chris Roberts, started in 1989
- Mike Marana, started in 1993
- Al Marquardt, started in 1993
- Nancy Mansfield, started in 1994
- Scott Robinson, started in 1998
- Vashoune Russell, started in 1998
- John Stone, started in 1998
- Marc Taylor, started in 1998
- Hank Kaczmarek, started in 1999
- James Phillips, started in 1999
- Kirby Vandivort, started in 1999
- Tracey Wszalek, started in 1999

I've been here since 1989 so it's my 25th anniversary as well. Probably the best moment I've had here was when I got the chance to drive Dr. Beckman and his daughter to his hometown to visit with an old friend for lunch. He was a very gracious and down-to-earth person who loved science. We also went by his childhood home, and it still had the old shed where he did his experiments when he was a child.

—Chris Roberts, Research Facility Attendant since 1989



Ted Brown, the founding director of the Beckman Institute, tours the construction of the Beckman Institute with Mabel and Arnold Beckman.



Beckman Institute Open House T-Shirt Design Contest

Deadline: Nov. 21, 2014

The 2015 Beckman Open House is scheduled for March 13-14, 2015, and for this year's open house, there will be a Beckman-wide contest for the t-shirt design.

The Rules

1. Should generally encompass all 4 main research themes of the Beckman Institute
2. Design should be on one side of the t-shirt only

Please send your designs to August Cassens at acassens@illinois.edu by Friday, November 21, 2014.



HONORS & AWARDS



Dilger Awarded Gift to Build New Biomedical Swine Research Unit

Mead Johnson Nutrition awarded a \$945,000 gift to Ryan Dilger of the Bioimaging Science and Technology Group to build a new biomedical swine research unit at the U of I that will increase the capability for research regarding learning and memory in young pigs with the goal of understanding how nutrition affects brain development in human infants.

Beckman Team Places in Top Three in Alan Alda Flame Challenge

Beckman Postdoctoral Fellows Brad Deutsch and Dave Mayerich and Beckman faculty members Rohit Bhargava and Scott Carney were finalists in the 2014 Alan Alda Flame Challenge, a competition that invited scientists to answer the question “What is color?” in a way that made sense to an 11-year-old.



Nahrstedt Appointed to Computing Council

Klara Nahrstedt, of the Image Formation and Processing Group, is one of six new members selected to the Computing Research Association's Computing Community Consortium Council.

NSF Awards EAGER Grants to Beckman Researchers

Two Beckman research teams, led by Stephen Boppart and Martha Gillette, have received Early Concept Grants for Exploratory Research (EAGER) awards from the National Science Foundation (NSF) to enable new technologies to better understand how complex behaviors emerge from the activity of brain circuits.



Moore Named Howard Hughes Medical Institute Professor

The Howard Hughes Medical Institute (HHMI) has named Jeffrey Moore, of the Autonomous Materials Systems Group, an HHMI Professor. Moore will receive a five-year grant from HHMI. According to the institute, “HHMI professors are accomplished research scientists who also are deeply committed to making science more engaging for undergraduates.”



Neal Cohen Named Interdisciplinary Health Sciences Initiative Director

In his new role, Neal Cohen, of the Cognitive Neuroscience Group, will work closely with researchers across campus, as well as the Offices

of the Chancellor, Provost, Vice Chancellor for Research, and relevant academic and research units, to develop a new Interdisciplinary Health Sciences Institute as envisioned in the Campus Strategic Plan.

Three Beckman Researchers Selected for NCSA Fellowships

Beckman researchers Narayana Aluru, Iwona Jasiuk, and Taras Pogorelov were three of the nine researchers from the U of I that have been selected to receive fellowships with research support that will enable them to pursue collaborative projects with the researchers and computer technology experts at the National Center for Supercomputing Applications (NCSA).



Jain Receives Beckman Young Investigator Award

Prashant Jain, of the Nanoelectronics and Nanomaterials Group, is one of seven recipients of the Beckman Young Investigator Award from the Arnold and Mabel Beckman Foundation. Jain received an award of \$750,000 over four years for his work on nanoscale imaging of catalysts in action.

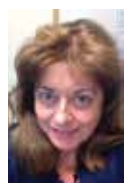


Kumar Receives Piero Zamperoni Best Student Paper Award

Avinash Kumar, a graduate student at Beckman, was recently honored with the Piero Zamperoni Best Student Paper Award for his paper titled “Generalized Radial Alignment Constraint for Camera Calibration” at the International Conference on Pattern Recognition. Kumar is advised by Beckman faculty member Narendra Ahuja, who also co-authored the paper.

NSF Awards \$8 Million Renewal Grant to the Center for Physics of Living Cells

The Center for Physics of Living Cells has received an \$8 million 5-year grant renewal from the NSF to continue its research, education, and outreach missions. Center personnel include Beckman researchers Taekjip Ha, Klaus Schulten, Aleksei Aksimentiev, Martin Gruebele, Zan Luthey-Schulten, and Steve Sligar.



Fabiani Named Editor-in-Chief of *Psychophysiology*

As of January 1, 2015, Monica Fabiani, of the Cognitive Neuroscience Group, will be the editor-in-chief of the journal *Psychophysiology* (Wiley-Blackwell).

Taking a look into the Beckman Institute archives...

1. Former Beckman Postdoctoral Fellows, from left, Ilya Zharov (2000), Lolita Rotkina (1999), and Slava Rotkin (2000).
2. Arnold Beckman plays the piano at an event to celebrate Beckman's 10th anniversary and Arnold's 99th birthday.
3. Before the Biomedical Imaging Center was in place at Beckman, Beckman researchers utilized functional imaging resources at Carle Hospital. Pictured are Beckman researchers Andrew Webb (second from left), Marie Banich, Art Kramer, and Neal Cohen, with Dr. Joseph Barkmeier of Carle.
4. Open House 1997: Narendra Ahuja, John M. Hart, and colleagues developed a computerized "cockroach" that had sensory feedback capabilities and could recover its balance.



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 spotlights the people and science that make the Institute one of the premier facilities for interdisciplinary research in the world.

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