

SYNERGY

BECKMAN INSTITUTE FOR ADVANCED SCIENCE AND TECHNOLOGY

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Justin Rhodes of Beckman's NeuroTech group started a unique research line using marine fish that can change sex.

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Beckman Institute Postdoctoral Fellows come from around the world to take advantage of the opportunities offered by the program, now in its 20th year.

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Jose Jimenez is a former Beckman Fellow and current industry researcher who learned some valuable lessons about communicating science while at the Institute.

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Beckman Institute faculty member Amy Wagoner-Johnson shifted her research focus to investigate using artificial bone for biomedical applications.

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Nemo Meets Neuroscience

Beckman Researcher Justin Rhodes Uses Fish for Neuroscience Insights

You won't find Nemo swimming around in Justin Rhodes's new marine biology laboratory at the Beckman Institute, but you will find 74 of his real-life clownfish brethren in one of the most unique settings for neuroscience research in the world.

Almost every child knows the story of Nemo, the digital namesake of the hit movie whose story made clownfish as well-known among kids as 101 Dalmations did for that breed of canine years ago. As compelling as children and many adults found the story of Nemo, the real-life biology of clownfish is just as intriguing to Rhodes for what it might reveal about environmental influences on the evolutionary biology of the brain.

Add in the fact that the Beckman researcher has had a lifelong passion for aquariums and fish and what you get is more than 1,000 gallons of water and a variety of marine life forms in Rhodes's new marine biology research lab on the third floor of the Institute. Inside are two aquariums housing clownfish for studies and ocean rocks and faux sea anemones to make them feel at home, as well as a special smaller display aquarium featuring an assortment of coral reef fish.

The three aquariums in the remodeled lab space, which was completed in August of 2010, include one 900-gallon system and a 200-gallon system dedicated to the clownfish. The 100-gallon display aquarium abuts a lab window along the third-floor hallway so passers-by can enjoy the six varieties of beautiful and interesting coral reef fish.

"I've had aquariums my whole life," Rhodes said. "I've got a big aquarium at

home. I've loved them since I could talk and I always wanted to be an ichthyologist. This has been my dream."

Only Rhodes won't be studying the clownfish the way an ichthyologist might; rather it is the ability to change sex that interests him as a neuroscience researcher. In



Justin Rhodes talks about the aquariums in his new marine biology lab.

fact, Rhodes says, if the creators of *Finding Nemo* had been true to nature, after mom was eaten by a barracuda, dad wouldn't have gone off looking for his son Nemo; instead, dad would have turned into a mom and then caught the EAC (East Australian Current to the uninitiated) in search of their last living offspring.

"Almost all the coral reef fishes you see change sex; most of them change from female to male but the clownfish changes from male to female," Rhodes said. "Clownfishes

are perfect because they have a very small environment in nature so they are very happy in an aquarium. I'm fascinated by sex change and this is a species that is conducive to being studied in the lab."

Rhodes's passion for aquariums and fish predates elementary school, beginning, he says, about age 5. He worked at the American Museum of Natural History in New York City while in high school, single-handedly resurrecting their fish lab. Rhodes later earned a master's degree in Fisheries at the University of Washington, and then a Ph.D. in Zoology from Wisconsin-Madison. His appointment at the University of Illinois is in the Department of Psychology, Biological Division, and at the Beckman Institute he is a member of the NeuroTech group.

So it's no surprise that Rhodes initiated a research line studying fish for insights into neuroscience. What is surprising is that he is the only one doing this kind of research using fish as a model organism.

"It's amazing to me that no one in the world is doing it," Rhodes said.

"There are a few papers done from friends of mine but those are field studies. I've confirmed that because I have a friend, John Godwin, who is the guru of the sex change current and he said 'yeah, it's a great idea, no one's doing it'. So it's very unique."

The Rhodes Laboratory at Beckman has a research focus on the neurobiology of behavior and on genetics, studying topics like the effects of exercise on the brain and cognition and the causal mechanisms underlying behaviors like addiction.

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Rhodes is one of several researchers whose work has shown that the brain undergoes change on an ongoing basis. Rhodes and other Beckman researchers have focused on the effects of exercise on the brain, as part of research demonstrating brain plasticity, or the idea that brain structure is much more plastic and amenable to rewiring than previously thought.

In his previous work Rhodes has used mice as a model for studying how environmental factors such as exercise can change brain structure and behavior, but is now adding the clownfish as a model because of that one amazing capability the species has to change sex.

“It fits the research pattern of trying to understand how the environment and experience of an animal can have long lasting changes in their patterns of behavior,” he said. “This is just a very dramatic example of that where the experience in the brain is actually changing the entire sex of animals engaging in this incredible plasticity.”

Rhodes said he was interested in studying the effects of exercise in mice because the physical activity has been shown to stimulate neurogenesis, or the growth of new brain cells, in an example of the brain’s plasticity. The clownfish offers more opportunities for those types of studies.

“The joke in the lab actually is that, the fish changing sex, now *that’s* plasticity,” Rhodes said. “I mean that’s an incredible amount of plasticity where the experience and the environment that the animal’s in, through the brain, through the nervous system, is able to completely re-orchestrate, re-program the body and change the morphology. We want to understand how that works, how the brain interprets the change in the social environment and how that’s signaled through hormones.”

Rhodes said another interesting neuroscience topic to explore with the clownfish is sex differences in the brain.

“For example, there are lots of effects of testosterone that are probably not functionally relevant like male-pattern baldness, which is a result of testosterone, but probably has no functional significance,” he said. “How do we figure out what’s functional? It’s difficult. In the fish, though, if we can track the brain changes that occur when an animal is changing from a male to a female, or the other way around depending on the species, we can then find out.”

The new lab is an opportunity for Rhodes

to return to his roots by studying fish, but it took the fortuitous arrival of student Derrick Stobaugh to get the project started. Rhodes said Stobaugh was an outstanding undergraduate student in his evolutionary neuroscience class, so he invited him to work in the lab.

“I always send out notices for students to get involved with internships and I mentioned there was one at Woods Hole and he said he was really interested in marine biology,”



“The joke in the lab actually is that, the fish changing sex, now *that’s* plasticity.”

– Justin Rhodes

Rhodes said. “I asked him why and he started telling me how his family had a fish store, and then I met his dad, who is a distributor. So he kept fishes his whole life and he had a lot of great contacts.”

Rhodes designed the layout of the aquarium systems in the lab and a company from Florida built to his specifications and sent them to Illinois. The lab took about four months to set up and, after a hitch or two, the aquariums were up and running and Rhodes had a new research line. He hopes to get future funding for the research line from the National Science Foundation (NSF).

“It’s a novel model organism, which the NSF likes to fund,” he said. “Also, it’s a perfect Beckman opportunity because, to really understand this kind of orchestrated sex change, you need to have multiple investigators looking at it.”

Rhodes plans to collaborate with other researchers, investigating topics such as those involving the pituitary gland, and he is using techniques from his previous work to study new neuron formation in the clownfish.

“We have a specific hypothesis that during sex change this part of the brain called the pre-optic area will grow or reduce the numbers of GnRH neurons,” Rhodes said. “We have some evidence of that from previous studies, but no one has really looked at the growth of new neurons in that part of the brain.”

The display of coral reef fish was created simply to let people know about their work and to let others experience the beauty of an aquarium.

“The fish that I put in there were chosen because they are beautiful but also because they have some interesting biologies,” Rhodes said. “There’s one fish in there that’s a simultaneous hermaphrodite, it has both male testes and ovaries at the same time throughout its entire life. No fresh water fish that we know of changes sex, whereas with marine fishes, it’s very common.”

That meant that if Rhodes wanted to study sex-changing fishes, he was going to have to use marine varieties. He said it has only been in the last 20 years or so that technology reached the point where smaller aquariums could play host to marine fish. What is required, he said, is a really good biological filter. In the marine biology lab, they use blue and green bio-balls, scumbag filters which can be taken out and washed, and a protein skimmer.

The coral reef fish display includes a Red-knobbed Starfish with an interesting feeding method, a Red Lionfish with multi-colored spines, a two-tone Blue Tang with a bright yellow tail fin, a Yellow Tang, a Queen Coris, and a Tobacco Basslet. Rhodes’s passion really comes to the fore when discussing the display fish.

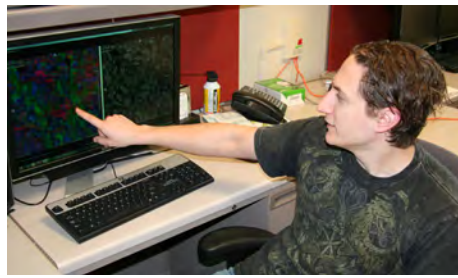
“The lionfish is really interesting because they have those poisonous spines that can paralyze,” he said. “That starfish is really cool because it’s predatory. It’s really fun to see because if you feed it a fish, its stomach actually leaves its body, surrounds the fish, digests it, and then pulls it back in. These starfish can eat clams and things like that, that are completely closed because their stomach can go into tiny little holes and their stomach can go outside their body, into the clam, surround the clam and pull it back out. So it’s fascinating to watch.”

The clownfish aquariums include sea rocks with micro-organisms popping out on some, the faux sea anemones (real-life versions are habitats for the clownfish in their natural setting) and a shell crab in one aquarium. The clownfish not only are used to living in a small environment in the sea but they also live in pairs, as they do in Rhodes’s lab.

“They’ve been reared in farms so they’re even a bit more likely to be happy to be in aquariums,” he said. “As you can see, all the fish in here are very happy.”



Malini Ranganathan



David Mayerich



Eddie Wlotko

Freedom
+
Funding
+
Flexibility
=
A Beckman
Fellow

As a Beckman Fellow, David Mayerich discovered a completely new outlet for his skills in reconstructing biomedical imaging data: applications in cancer research. New Fellow Malini Ranganathan is taking results from fieldwork she did tens of thousands of miles from Illinois and forging a unique research line involving the political ecology of water. Eddie Wlotko spent many hours as a graduate student toiling in a Beckman Institute lab, but was thrilled when he found out he could continue working here as a Beckman Fellow after earning a Ph.D.

They are just three of 12 current Beckman Institute Postdoctoral Fellows who are given a stipend and other resources and are asked in return only to continue doing research. Ranganathan knows she is fortunate to be a Beckman Fellow, in part because there are no teaching duties or other requirements to distract from her research goals, and in part because of the resources a Fellow enjoys.

“It’s rare to have a period in your life where you are using the time just to work on the things you want to work on,” she said. “It’s a privilege to be in this spot.”

Ranganathan, like the other current Beckman Institute Postdoctoral Fellows, didn’t just fall into her position. She and the other Fellows earned their spots by being among the top Ph.D. candidates or postdoctoral researchers in their respective fields. Ranganathan, who came here in late last year, was one of only five out of 59 applicants chosen for the 2010 class of Beckman Postdoctoral Fellows.

Fellows come to Beckman from around the globe and work in so many different areas there is no way to summarize all their research. They come with Ph.D.s in hand from the top universities across America, Europe, and a few other distant corners of the world. They do research in everything from neuroscience to robotics to the environment to nanoelectronics.

The Beckman Institute Fellows program was begun in 1991 and is funded by the Arnold O. and Mabel M. Beckman Foundation. It was created to give recent Ph.D. students an opportunity to do research before they begin their professional careers, without having to worry about funding or having teaching or other duties. Michael Walsh holds the unique position of being the first-ever Carle Foundation Hospital/Beckman Institute Fellow, a position that was created in 2008 and is funded jointly by the hospital and the Foundation.

Four to five Fellows are selected each year from the areas of the behavioral and biological

sciences, chemistry, engineering, and physics for appointments of up to three years and are, according to the guidelines, selected “on the basis of their professional promise, capacity for independent work, interdisciplinary interests, and outstanding achievement to date. Preference is given to those applicants whose research interests correspond to one or more of the programs in the Beckman Institute.”

The Beckman Postdoctoral Fellows are given an office, computer resources, and staff support from the Beckman Institute. Beckman Fellows are expected to collaborate with faculty researchers, as well as work independently doing interdisciplinary research. For many, it is a time to continue and/or expand research lines begun while earning degrees, while also preparing for an academic, business, or government position.

Former Fellow Jose Jimenez says that the most important thing he took away from his experience was learning the importance of having a big picture view of science.

“The details help you to write a paper, to advance the field, but to make strategic decisions doesn’t come from super specialization, it comes from understanding the field in which you are working,” he said. “The Beckman Institute allows you that because you can interact with more people and see a completely different picture than as an individual Ph.D. student in a group.”

When some of the current Fellows

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describe the advantages of their position, interestingly the terms seem to all start with the letter f: freedom, flexibility, and funding. The current Fellows echo the program's mission statement, which states it "provides an excellent opportunity for young scholars

Beckman administration office is," Wlotko said. "Van Anderson in particular made sure that I was aware of all the different resources that were here and that I met someone from every department in the Beckman. So it's really been great.

Hong Kong. Ranganathan did field work in Bangalore, India, and the Philippines that she is now applying to her appointment in the Social Dimensions of Environmental Policy strategic initiative headed by Beckman's Jess Ribot that also includes Fellow Jeremy Brooks. In Bangalore, she focused on neighborhood associations and how they could impact internal distribution of water resources. She describes herself as "a scholar of the environment.

"I'm interested in contributing to our understanding of human-environment interactions and looking at the political, social, economic and technological aspects of human-environment interactions," she added. "We are living in a time where for the first time in human history over half the human population is urban. This is unprecedented. The areas of fastest and most rapid growth are developing cities.

"Now take that problem and combine it with the fact that 1.2 billion, and some estimate it's up to two billion people, who don't have access to safe water sources or sanitation. So you take those two major problems and I would say my research fits squarely at the intersection of the urban phenomenon and the lack of water phenomenon."

After all her travelling and fieldwork and doctoral dissertation writing, Ranganathan said she likes having an office and colleagues here at Beckman and in the Department of Geography at Illinois, as well as a more academically-oriented schedule.

"It's different than my Ph.D. in that I am able to show up and have an office and a sense of having colleagues," she said. "Ph.D. writing is very isolating whereas I want this to be different. I can make a meeting on campus. Here I'm hoping with Jesse and with people in Geography and with cross university collaborations as well, to be able to have more of that sense of doing research together."

Mayerich's doctoral work involved the development of methods for reconstruction and visualization of magnetic resonance imaging (MRI) and computed tomography (CT) biomedical data with the aim of giving new insights into anatomy at the sub-cellular level. As a Fellow, he has the same goal in developing methods for high throughput microscopy, but the differences lie in the amount of data produced with the latter technique. Mayerich also has a completely new application for his methods; he is

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"I think the best part is the flexibility given you to fulfill your career goals. It's also the idea of being an entrepreneur, of being someone who creates your own agenda, your own research and networks."

– Malini Ranganathan

to initiate a post-Ph.D. career of independent research in a stimulating and supportive interdisciplinary environment."

Ranganathan, who is focusing on issues such as access to water in developing countries, cited the flexibility Fellows have in pursuing their research.

"Whenever I describe that for my colleagues they acknowledge that it's a really good deal," she said. "But they also expect you to have a lot of responsibility and be a self-starter because it's up to you to make what you can out of this time here.

"I think the best part is the flexibility given you to fulfill your career goals. It's also the idea of being an entrepreneur, of being someone who creates your own agenda, your own research and networks."

Mayerich, who earned a Ph.D. from Texas A&M in Computer Science, said funding is key to the freedom that Beckman Fellows enjoy.

"One of the biggest things that a faculty member has to deal with is being able to get funding and to manage funding," he said. "I think the experience of being able to freely manage a budget has been nice, especially," he added with a laugh, "since I as a computer scientist can make these things stretch pretty far. Some of the other Fellows, they have to buy a lot of lab stuff, whereas I just need a really solid computer."

Wlotko is a homegrown Fellow, earning a Ph.D. from the Department of Psychology at the University of Illinois. He said the transition from graduate student to Beckman Fellow was a smooth one.

"I remember in the orientation just being really impressed by how organized the

"We have the means to do our own research and more and more, I understand, that is very unusual. If you are not faculty it's very unusual to pick a project and run with it."

In their applications to join the program, Fellows propose research projects and collaborations they expect to have if selected for an appointment.

Wlotko, for example, worked with Beckman faculty member Kara Federmeier while earning a Ph.D. that had a focus on how the two hemispheres of the brain each serve language functions that are necessary for comprehension. He now collaborates with the Institute's Monica Fabiani and Gabriele Gratton in their Cognitive Neuroimaging Laboratory (CNL). He said his day-to-day life as a Fellow isn't much different than his grad school days working in Federmeier's lab, but two aspects of his research are different.

The measurement technique Wlotko used in Federmeier's lab recorded the electrical activity of the brain, while in the CNL he records optical signals in the brain. In addition, his research has expanded to include studies of hemispheric contributions to language comprehension in older populations, across the lifespan.

"I thought I would have a little bit less time in the lab when I started my postdoc but it hasn't really turned out that way," Wlotko said. "Just because there are so many things that I'm interested in and have grabbed my attention, so I'm working on many more things now."

Ranganathan is a child of the world, growing up with a diplomat father in places like Ethiopia, China, Russia, France, and

working with Beckman researcher Rohit Bhargava toward eventually applying the techniques to dataset visualization for cancer diagnoses.

"In most biomedical visualization everybody is working with MRI data and CT data and those datasets are relatively small and easy to reconstruct," Mayerich said. "There are certainly challenges there but when you compare them to high throughput microscopy data, you are talking about several megabytes up to several gigabytes and several terabytes of data. And that's just not possible to manage using these single threaded algorithms that people have been using for visualization for awhile."

So Mayerich is developing ways to process and visualize large datasets such as those produced by high throughput microscopy methods like infrared imaging. Mayerich said the work is necessary in order to fully realize the clinical potential of those microscopy techniques.

"The stuff that you can do with the infrared machines is really cool. It really changed my perspective on the direction that diagnosis in medical imaging is going, and there is a lot that we can do with it," he said. "The research that Rohit is doing is moving in the direction of more reliable, more specific diagnosis. It's something that uses only optical and computational techniques in order to get results."

Mayerich is like Ranganathan in that he doesn't have a lab. Most of his time is spent on the computer.

"You see me here a lot because my office is my lab," he said. "That I think is unusual because I know Michael Walsh spends a lot of time in the lab downstairs. I work with him and he gets the data and brings it to me. But there's always a lot of interaction. We always meet for lunch."

Being a Beckman Fellow is not a 9-to-5 job and Mayerich says there is a reason for that.

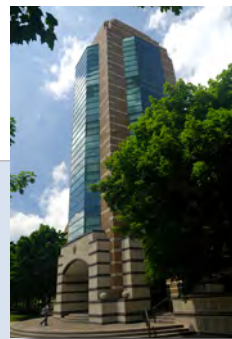
"Well, when you do what you like," he said with a chuckle. "Maybe since we just got into it, we're really excited. You have different goals, I think. When you're a graduate student you certainly want your professor to see you there. But here there are things I need to get done."

Applications for Carle Foundation Hospital and Haferkamp Scholarship Now Being Accepted

Applications for two important appointments at the Beckman Institute are now being accepted.

The Carle Foundation Hospital/Beckman Institute Fellow position is now open for applications. The Carle/Beckman Fellows program was begun in the Spring of 2008 to provide an opportunity for a recent Ph.D. or M.D./Ph.D. to conduct independent, interdisciplinary, oncology-related research at the Beckman Institute. Appointments are for up to three years and there are no teaching or administrative duties required. For more information, visit <http://www.beckman.illinois.edu/fellows/>.

The Erik Haferkamp Memorial Scholarship for Undergraduate Summer Research is for a University of Illinois undergraduate student who has worked in a Beckman Institute laboratory for at least one semester prior to the Summer 2011 semester to pursue neuroscience research at Beckman. For Summer 2011, one \$3,000 scholarship will be awarded. For more information, details on the application process, and eligibility requirements, contact HaferkampScholarship@beckman.illinois.edu. Applications are being accepted now through midnight on Friday, April 8, 2011.



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- **Erik Haferkamp Memorial Fund**
(supporting undergraduate research in neuroscience)

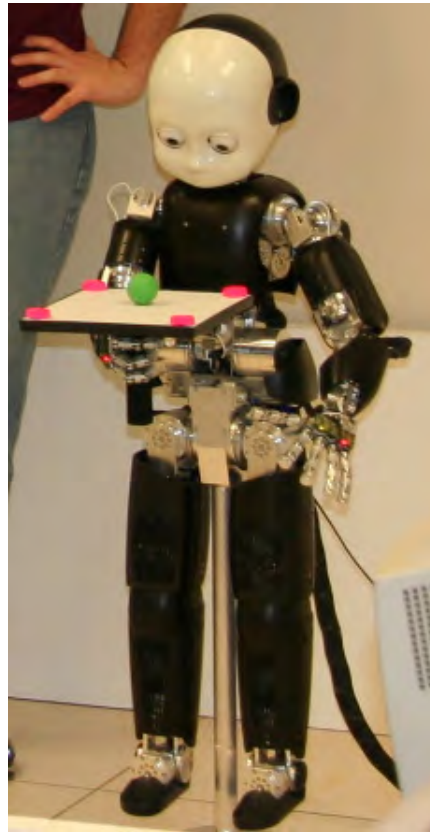
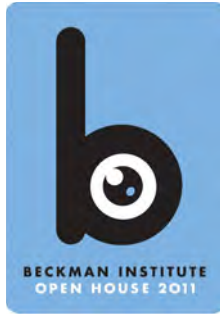
- **Nadine Barrie Smith Memorial Fund**
(supporting women engineers in medical imaging)

- **Thomas & Margaret Huang Fund for Graduate Research**
(supporting graduate research in human-computer intelligent interaction)

For more information, please contact:
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Beckman Institute Open House Successful, Attracts Thousands

Lighted yo-yos spun by kids of all ages and words like “awesome” and “cool” were in abundance March 11-12 at the 2011 Beckman Institute Open House. Thousands of visitors from Champaign County and beyond were given a firsthand look at the world of Beckman Institute science through the 38 exhibits put on by our research groups. Check out our photo gallery of the 2011 Open House: <http://bit.ly/gP0eCW>.



Images clockwise from left: Bert the iCub balances a ball on a plate; Prof. Chilin Shih interacts with a young visitor; a student tries the task at the NCN@illinois exhibit; Biomedical Imaging Center staff demonstrate what it is like to participate in a MRI test; visitors feel the bronze Braille sculptures while Sheila Schneider looks on; Darren Stevenson demonstrates the high speed camera in the Visualization Laboratory.



ALUMNI PROFILE



"I have a position of leadership here in this company, and a big part of that is the ability to communicate with people who are not as expert as I am in a specific area. Beckman is not the only place I learned that, but it played a big, big role. So I value that as something very important, the ability to talk to very different people."

Jose Jimenez

Jose Jimenez got a trial-by-fire introduction to the Beckman Institute and the concept of having multiple, unrelated disciplines and their faculty members in one building.

Jimenez was a new Beckman Fellow in 1993, brimming with the confidence that comes with a recently-earned Ph.D. and ready to tell the world about his doctoral work involving semiconductor theory. So when Karl Hess – a founding father of the Beckman Institute and leading theoretician in semiconductor physics – had one of his students ask Jimenez to give a presentation at a seminar series for the general public, Jimenez was unruffled. He had a one-hour talk ready to go, but never made it all the way through the presentation.

"I was grilled by Karl, questions like I had never had in my life," Jimenez recalled with a chuckle. "I really liked giving talks but I had professors tell me afterwards it looked more like an exam.

"A couple of days later I stopped by Karl's office and said 'Karl I don't know what happened. You grilled me with these difficult questions.' He said 'no, you did great. But I wanted to make a point.

This is the first time that I organized these talks and I wanted to make sure that people realize we are in a multidisciplinary center. We cannot give a talk with very technical language. We have to give it so people in different areas understand it.' This for me was very important. I didn't appreciate it at the moment but later on I did. I use that example all the time."

Jimenez is now a Senior Member of the Research and Development Technical Staff at TriQuint Semiconductor in Richardson, Texas. His work there in the Defense and Aerospace Business Unit involves the development of next-generation silicon technologies.

Jimenez's time as a Beckman Fellow was spent working with current Institute faculty member Jean-Pierre Leburton and former faculty David Brady, and also Hess, investigating the practical use of non-uniform quantum dots in electronics. But as or even more important than the research to his Fellow experience, Jimenez said, were the lessons he learned at Beckman about communicating science to those outside your own discipline.

"The things I worked on at Beckman and the things I am working on now are not directly the same, but they are very related," Jimenez said. "But what was more important for me at Beckman was actually the fact that I took very seriously the idea of multidisciplinary research, particularly the ability to speak with people who speak different languages, and I don't mean English or French.

"That has helped me enormously. I have a position of leadership here in this company, and a big part of that is the ability to communicate with people who are not as expert as I am in a specific area. Beckman is not the only place I learned that, but it played a big, big role. So I value that as something very important, the ability to talk to very different people."

Jimenez directs several university-related projects for TriQuint, and in those efforts and other dealings with the public, he practices what he preaches about communication. He is also passionate about industry and academia working together effectively, and gives talks on the subject. Jimenez said TriQuint and MIT currently have a very effective working relationship.

"The way to do it is by understanding the strengths of both places, the universities and the companies and working together with both benefitting from the information of the other," he said.

Jimenez said his most important research work while serving as a Beckman Fellow involved using the non-uniformity of self-assembled quantum dots toward applications in laser electronics technology. At TriQuint Semiconductor Jimenez's work involves the development of gallium nitride as a replacement for gallium arsenide in future electronics.

"It has much better properties than gallium arsenide, which is basically in almost every cell phone in the world," he said. "But slowly that will change. In the beginning gallium nitride technology will be adopted by the military but 10 years from now it will be commercial."

Jimenez said that early on he was intent on becoming a professor, but first chose to become a Beckman Fellow and then joined industry rather than take a faculty position.

"It was tough because the Beckman Institute and a university environment was the only world that I really knew," he said. "But if the best university would call me tomorrow there is no way I could say yes. There is so much to learn in a company. I think it is so important to learn while working in a company because of all the things they don't teach in a university."

FACULTY PROFILE

Like many who experience living abroad, Beckman Institute researcher Amy Wagoner Johnson says that a year-long stay in France as a teenager changed her life. It wasn't the rich French culture or history that had a profound effect so much as it was two realizations gained from the experience: one, that she could overcome obstacles, and two, that she had developed an interest in science.

"It was a huge influence in my life," Wagoner Johnson said of spending her junior year in a French high school.

"My parents say that the person I was before France and after France are like two different people," she added with a laugh.

Wagoner Johnson's father was on sabbatical in France from his position as a materials science professor at Ohio State. It was a year in which she became, thanks to her French physics teacher, truly interested in science and engineering, as well as confident in her abilities.

"I got good grades before France but it wasn't a huge challenge and I wasn't trying to challenge myself," Wagoner Johnson said. "I'm not an engineer who, when they were a little kid, tinkers with everything like my dad did. It wasn't until I was almost an adult that I decided that engineering was very interesting. I think going through this time in France showed me the value of being challenged and just learning that if I wanted to do something I could do it."

That perspective served Wagoner Johnson well in her academic and professional careers. She earned a Ph.D. from Brown University in engineering with a major in materials science and a minor in solid mechanics, later coming to Illinois for positions as an Assistant Professor in Mechanical Science and Engineering and as a member of Beckman's Bioimaging Science and Technology group. The lessons she learned in France also meant that if Wagoner Johnson found research interests outside her Ph.D. topic, she was going to explore them.

That is exactly what happened when she became interested in biomaterials following a talk in Boston from a physician who discussed clinical uses for artificial bone. When Wagoner Johnson came to Illinois in 2001 with her husband and fellow Engineering and Beckman colleague Harley Johnson, she was already thinking about a new direction for her research.



I knew when I finished my Ph.D. that I wanted to change fields and go more into biomaterials. This was applying engineering to problems in biology, which did appeal to me. I think the idea that you can relate to it on a more personal level was a factor for me.

Amy Wagoner-Johnson

"I knew when I finished my Ph.D. that I wanted to change fields and go more into biomaterials," she said. "This was applying engineering to problems in biology, which did appeal to me. I think the idea that you can relate to it on a more personal level was a factor for me."

Wagoner Johnson's current research does focus on biomaterials, specifically synthetic bone substitute materials and systems that could be used to replace bone grafts, where bone is harvested from the patient or obtained from donors.

"The biggest part of my research program is studying how we can take a synthetic material

and replace natural bone, specifically in large and complex defects," she said. "In injury cases or in cases of cancer or degeneration of tissue because of things like gingivitis, patients can be missing a very large piece of bone."

"We want to be able to customize these implants so that we can optimize the mechanical properties and optimize the bone in growth and healing process. To do that, I take it all the way from design and fabrication of an implant to in vivo studies."

Wagoner Johnson employs hydroxyapatite – a ceramic material commonly used in clinical settings for implant coatings and other applications – as a scaffold that is then modified at the macro- and micro-structural scales for customization. Her lab also studies and characterizes the biological response to the implant, using micro-computed tomography and the Visualization Laboratory at Beckman.

"We use micro-CT data to characterize bone in-growth into our scaffolds more quantitatively than people have done previously," she said. "We hope that it will help us better understand how and why the bone grows into the scaffold so they can eventually be used in a clinical setting."

Wagoner Johnson also contributed to the Mandible Project at Beckman which successfully demonstrated that an artificial bone implant could be used in place of bone harvesting. She said that experience helped teach her the importance of having biomedical engineering research that is connected to a clinical setting.

"I think sometimes as engineers we might not realize that," Wagoner Johnson said. "But it's important to talk to the clinicians because they know the other issues that come into play, the practicality of using it in the surgical suite, handling it, and how it would be attached. I would be very excited to see these scaffolds being used in a clinic someday."

Thanks to her own experiences, Wagoner said she encourages students to take on challenges.

"When I advise undergraduates, I always advise that they should go study abroad," she said. "It was a year that was very important in terms of milestones in my life. It was very influential in terms of what I did. It was a really hard year and very, very challenging but it taught me that if I wanted to do something I could do it."



HONORS & AWARDS

ROGERS ELECTED TO NATIONAL ACADEMY OF ENGINEERING



Rogers

Beckman Institute researcher John Rogers has been elected to the National Academy of Engineering. Rogers, a pioneering researcher in the area of flexible electronics, was chosen for his novel electronic and optoelectronic devices and systems for the award, which is one of the highest professional honors given to an engineer.

SCHULMERICH WINS BURSARY AWARD



Schulmerich

Beckman Institute researcher Matthew Schulmerich recently earned the 2011 Gordon F. Kirkbright bursary award from the Association of British Spectroscopists (ABS) Trust. Schulmerich, a researcher with the Bioimaging Science and Technology group, will be using the award to attend the International Institute of Continuing Medical Education's workshop on breast imaging this March.

LYDING, KALE NAMED AS IEEE FELLOWS



Lyding

Beckman Institute researchers Joe Lyding and Laxmikant Kale have been elevated to the position of IEEE Fellows. Lyding is head of the Nanoelectronics and Nanomaterials group at Beckman and Professor in the Departments of Electrical and Computer Engineering and Bioengineering at the University of Illinois. Kale is a researcher



Kale

in the Theoretical and Computational Biophysics group and a faculty member in the Department of Computer Science. Lyding received the honor for his contributions to nanofabrication and metal-oxide semiconductor transistor reliability. Kale was chosen for his contributions for development of parallel programming techniques.

IEEE is the world's largest technical professional society. According to IEEE, the selection as an IEEE Fellow is one of its most prestigious honors, and is "bestowed upon a very limited number of Senior Members who have made outstanding contributions to the electrical and information technologies and sciences for the benefit of humanity and the profession." The number of IEEE Fellows given this distinction in a year is no more than one-tenth of one percent of the total IEEE voting membership, with 321 new Fellows elevated this year.

BOPPART CHOSEN AS IEEE FELLOW



Boppert

Beckman Institute researcher Stephen Boppert has been chosen as an IEEE Fellow for his contributions to optical biomedical imaging. Boppert is Co-chair of Beckman's Integrative Imaging research theme and a professor in the departments of Electrical and Computer Engineering and Bioengineering at the University of Illinois. Boppert was named a Fellow by the Board of Directors of IEEE, the world's largest technical professional society. According to IEEE, his selection as an IEEE Fellow is one of its most prestigious honors, and is "bestowed upon a very limited number of Senior Members who have made outstanding contributions to the

electrical and information technologies and sciences for the benefit of humanity and the profession." The number of IEEE Fellows given this distinction in a year is no more than one-tenth of one percent of the total IEEE voting membership, with 321 new Fellows elevated this year.

RESEARCHERS WIN INNOVATE ILLINOIS AWARD



Carney

Diagnostic Photonics, a local start-up company based on the research of Beckman Institute faculty members Stephen Boppert and Scott Carney, was one of four top winners in the 2010 Innovate Illinois competition.

Innovate Illinois is a statewide competition sponsored by the Illinois Department of Commerce and Economic Opportunity to recognize high-growth entrepreneurs.

RECENT BECKMAN INSTITUTE RESEARCH IN THE NEWS



BRIEF DIVERSIONS VASTLY IMPROVE ABILITY TO FOCUS

February 08– Alejandro Lleras of the Beckman Institute’s Human Perception and Performance group has published a study challenging conventional thinking on the nature of attention. In a recent paper Lleras reports on research demonstrating that diversions, even for short periods of time, from a task can dramatically improve a person’s ability to focus on that task for prolonged periods.

U of I News Bureau

POWERS ASSESSES HUMAN-COMPUTER CHALLENGE

February 07– Richard Powers of the Beckman Institute’s Cognitive Neuroscience group weighs in on the upcoming Jeopardy Grand Challenge pitting an advanced computing system against two human champions and the import of the match for artificial intelligence. “The real showdown is between us and our own future,” Powers write in a New York times opinion piece.

New York Times

MODERATE AEROBIC EXERCISE IN OLDER ADULTS SHOWN TO IMPROVE MEMORY

January 31 – A study led by Beckman Institute Director Art Kramer and former Beckman researcher Kirk Erickson of the University of Pittsburgh has shown that one year of moderate physical exercise can increase the size of the brain’s hippocampus in older adults, leading to an improvement in spatial memory. The research, reported in the Proceedings of the National Academy of Sciences, is considered to be the first study to focus on older adults who have already experienced atrophy in the hippocampus area of the brain, a structure which is involved in all forms of memory formation.

University of Pittsburgh

THE TRUTH ABOUT LIES

January 31 – Beckman researcher Dan Simons is interviewed and featured as an animation in the Josh Landis and Mitch Butler segment of “The Fast Draw” that aired on January 30, 2011.

CBS Sunday Morning

IN THE BLINK OF BIRD’S EYE, A MODEL FOR QUANTUM NAVIGATION

January 28– The work of Klaus Schulten of Beckman’s Theoretical and Computational Biophysics group is cited in an article about how birds use the Earth’s magnetic field to navigate.

Wired

NEW CLASS OF FLEXIBLE SOLAR CELLS DEVELOPED

January 27– Beckman Institute researcher John Rogers and his collaborators report on flexible solar cells with high areal coverage. Rogers, a member of Beckman’s 3D Micro- and Nanosystems group, and his collaborators report on their work in the journal Advanced Materials.

Materials View

RUSSIAN MONEY REVIVES PLASTIC LOGIC

January 25 – John Rogers of the 3-D Micro- and Nanosystems group comments on a new megadeal that looks to revive the field of plastic electronics.

nature.com

IN NEW MILITARY, DATA OVERLOAD CAN BE DEADLY

January 19– Beckman Institute Director Art Kramer is quoted in an article about the problems the military is facing with data overload. .

New York Times

SELF-ASSEMBLING STRUCTURES OPEN DOOR TO NEW CLASS OF MATERIALS

January 18 – Beckman Institute researcher

Steve Granick led a project that developed tiny spheres that attract water to form “supermolecule” structures.

U of I News Bureau

RESEARCHERS PREDICT APTITUDE USING BRAIN IMAGES

January 14– A brain imaging study led by Beckman Institute Director Art Kramer has demonstrated “unprecedented accuracy” when it comes to predicting how well people will do on a complex task such as playing a video game. The imaging work for the study of brain function was performed at Beckman’s Biomedical Imaging Center.

News Bureau

NEUROSCIENCE: IS IT ALL IN YOUR MIND?

January 10– A journal article by faculty member Diane Beck of the Beckman Institute’s Cognitive Neuroscience group is cited in a story about how data from neuroscience studies are often misunderstood.

Miller-McCune

MCAULEY GIVES INPUT ON EXERCISE EFFORTS

January 10 – The work and opinions of Beckman Institute researcher Edward McAuley are featured in an article about motivation to exercise and become fit. McAuley is a member of Beckman’s Human Perception and Performance group.

Chicago Tribune

CHEMISTRY: THE TRIALS OF NEW CARBON

January 06– Beckman Institute researcher John Rogers is featured in a Nature News story about the advantages graphene may have for commercial applications over its elemental cousins, fullerenes and carbon nanotubes.

naturenews

continued on page 12

RECENT BECKMAN INSTITUTE RESEARCH IN THE NEWS

CLOAKING DEVICE HIDES UNDERWATER OBJECTS FROM SONAR

January 05—Beckman Institute researcher Nicholas Fang reports on a cloaking device made of materials that can hide structures from a wide range of sound waves in a paper for the journal *Physical Review Letters*. Fang, a member of Beckman's 3D Micro- and Nanosystems group, is a leader in developing acoustic and optical "superlenses" using metamaterials.

U of I News Bureau

ON BUILDING A BETTER BRAIN

January 03 – The work of Beckman Institute Director Art Kramer is cited in a *Newsweek* article on ways to improve our brains.

Newsweek

RESEARCHERS WIN INNOVATE ILLINOIS AWARD

January 03 – Diagnostic Photonics, a local start-up company based on the research of Beckman Institute faculty members Stephen Boppart and Scott Carney, was one of four top winners in the 2010 Innovate Illinois competition. Innovate Illinois is a statewide competition sponsored by the Illinois Department of Commerce and Economic Opportunity to recognize high-growth entrepreneurs.

The News-Gazette

BECKMAN PART OF NANOWIRE SENSOR DESIGN PROJECT

December 15– The Beckman Institute and other units at the University of Illinois are joining with the Institute of Microelectronics, an institute of the Agency for Science, Technology and Research in Singapore, on a project for identifying and defining the ground rules for the systematic optimization of nanowire sensor design.

nanowerk.com

STRETCHABLE SILICON HEADED FOR SPORTS APPAREL MARKETPLACE

December 10– Stretchable silicon, developed by Beckman Institute researcher John Rogers, could soon be used in sports apparel to monitor athletic performance thanks to a deal between Rogers's flexible electronics company and Reebok. It is just one of many potential applications for the flexible electronics technologies that have been developed by Rogers and his group.

Technology Review

CONTROL ENHANCES LEARNING MEMORY

December 06– Beckman Institute researchers Neal Cohen, Joel Voss, Brian Gonsalves, and Kara Federmeier are authors of a new study showing that having some control over a learning situation enhances the ability to remember what was learned. They report their findings in a paper in the journal *Nature Neuroscience*.

U of I News Bureau

THE WATER DANCE

November 30– The work of Beckman Institute researcher Martin Gruebele is discussed in a story about studies of the movements of water molecules. Gruebele is a member of Beckman's Nanoelectronics and Nanomaterials group.

physorg.org

THE GPU COMPUTING REVOLUTION

November 23– Beckman Institute researcher Klaus Schulten talks about the advantages that Graphics Processing Units (GPUs) bring to computational methods such as the molecular dynamic simulations performed by his Theoretical and Computational Biophysics group.

C&EN



Connected!

Beckman Institute Creates Presence on Social Media Sites

The Beckman Institute is linked in, tweeting, and friending, reaching out to alumni, faculty, students, and our friends through social media sites to share the exciting news of our research efforts.

Facebook

www.facebook.com/BeckmanInstitute

LinkedIn

www.linkedin.com/oups?gid=1836347&trk=myg_ugrp_ovr

Twitter

www.twitter.com/BeckmanInst

YouTube

www.youtube.com/BeckmanInstitute

So, check us out at these sites and share the news about the Beckman Institute and the leading edge interdisciplinary research that takes place here every day.



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