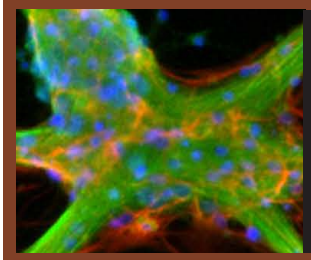
SYNERGY

FALL 2006 BECKMAN INSTITUTE FOR ADVANCED SCIENCE AND TECHNOLOGY ISSUE 3

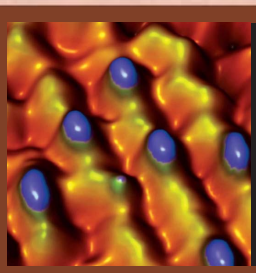
The Echo Maker

a novel

Richard Powers weaves neuroscience and nature in his new book, *The Echo Maker*, to explore the stories of what makes us who we are. Page 2



The Beckman Institute and researchers like Michael Insana are leading the way in the growing field of bioimaging. Page 5



Before being honored as one of the top young scientists in the country, Mark Hersam gained some vital experience during his time at Beckman. Page 11

The ability to continue the interdisciplinary approach he enjoyed at Bell Labs was one reason Richard Sproat joined the Beckman Institute. Page 14

ILLINOIS BECKMAN INSTITUTE AT THE UNIVERSITY OF ILLINOIS

Question and Answer with Richard Powers

Richard Powers is one of America's most acclaimed novelists and a faculty member in the Beckman Institute's Cognitive Neuroscience group. Powers, a professor in the Department of English, has earned numerous literary and academic awards and honors, including *Time* magazine Book of the Year Award, four National Book Critic Award finalist nominations, an American Academy of Arts and Sciences Fellowship, and a MacArthur Fellowship. On November 15 his latest novel, *The Echo Maker,* won what many consider the highest honor for works of fiction, the National Book Award for Fiction.

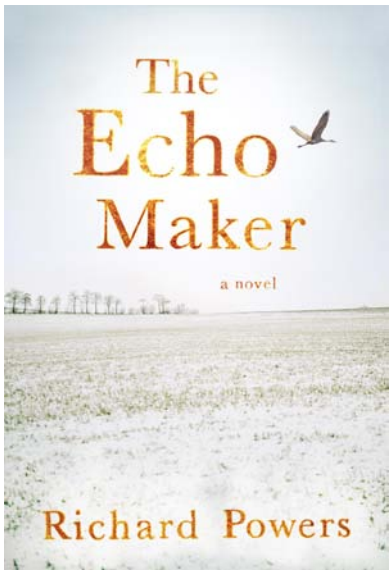
Powers had been at Beckman in the 1990s, then returned to the Institute last year to continue researching and writing *The Echo Maker*, a book that weaves family tragedy and the annual migration of the Sandhill cranes to Nebraska's Platte River into a story that probes basic questions about the self.

Powers read the neuroscience literature, attended seminars, and talked with neuroscientists at Beckman and elsewhere in researching the book. *The Echo Maker* tells the story of Mark Schluter, a 27-year-old Nebraska slaughterhouse worker whose truck accident leaves him with a rare case of Capgras syndrome. Unable to recognize his sister or even his dog, Schluter is trapped inside a mind that is connected to his old self in many ways but strangely disconnected to those people and things that were most familiar to him before the accident. A famous neurologist, Dr. Gerald Weber, is brought in and a story unfolds that reveals how fragile our connections to the world can be and how amazing the workings of the mind really are. *The Echo Maker* is Powers' ninth novel and was composed with a tablet PC using speech recognition software.

– Steve McGaughey, Beckman Institute Writer

SM: You've been at Beckman since March of 2005. How did you end up here?

RP: This is my second time through. When I first came back to the States after living in the Netherlands for many years and was invited by Illinois to stay as an artist-in-residence, Dick Wheeler and Ted Brown – who was head of the Beckman then – came up with this plan to give me an office and an affiliation here; this was in 1992. And by spending that year here, I came up with the idea for *Galatea 2.2*. There's a fictionalized Center in that book that's sort of a thinly disguised Beckman. So after finishing that book I gave up the office and went back south of Green to the English Department and stayed there, wrote some more books and taught some classes and helped start the graduate program, the Masters in Fine Arts degree that the English Department now issues. I'd been teaching with them for some years when I started working on this book with neuroscientific themes. I realized that I needed to come back and test my story against the stories that were unfolding here and the research that was being done. I came back a year ago last spring and have been enjoying being a fly on the wall once again.



SM: What do your interactions with neuroscientists at Beckman consist of and did they influence *The Echo Maker*?

RP: Very much so. I was working on the book and had done a lot of research in print and also in interviews prior to coming here. But once I was here I had several new avenues of connection and new resources available. One was access to informal conversations with scientists here, and that's been invaluable. The number of times that somebody has pointed me to other bibliographies, to an error in my preconceptions, or just to new and exciting research, I can't count. Just in casual conversations. Beyond that, I've had several chances to sit down with some incredibly exciting researchers like William Greenough and Neal Cohen, people who were working in areas that were important to my own narrative. The ability to sit and be in seminars with them and pick their brains one on one was really invaluable to me. Then I also started to attend the regular research seminars here, for instance the Advances in Sensory and Developmental Neuroscience events. That's where folks are bringing stuff fresh out of the lab and putting it up for public discussion, even stuff that is still in formulation. The benefits of that were really two-fold: learning about research before it actually hit publication, just as a sense of where things are going right now. But also a chance to see as an observer – but someone sitting in the same room – the whole culture of science. The way that scientists interact with each other as people was very interesting and eye-opening and part of the story that I ended up creating.

SM: There are numerous references to real world neuroscience cases in the book, such as HM, the man Neal Cohen discussed in his Director's Seminar talk Oct. 20 of 2006. How much research did you do before sitting down to write and why was Capgras syndrome the choice for Mark, the character the story revolves around?

RP: I did hear the Director's Seminar and Dr. Cohen's work is just stunning. I was knocked out by that. But I have had a couple of chances to talk to Neal privately and I also heard a similar talk that he had given in the past. I was participating in a memory seminar that he also participated in and, of course, I read him. So being at the Beckman was an exciting way to connect the formal presentation of these insights and discoveries as you come across them in published form with the actual guy doing the work. To see what he's like and what his

fears and his hopes and his dreams are. That was very thrilling to me. I had read him on HM and read a lot about other people's research with HM, but to actually hear him stand up and talk personally about the narrative of his experience with this guy, the kind of stuff that you can't put into scholarly publications, was really useful to me.

SM: In *The Echo Maker*, the neurologist Weber, when assessing his career, wonders about consciousness – what are its neurological correlates, do we have free will, etc. After researching and writing this book, what are your thoughts on what neuroscience tells us about the "basic riddle of conscious existence"?

RP: What's really interesting about writing this book and publishing it in the year 2006 is I think we're right in the middle of a complete transformation of attitude, even toward asking that question. In other words, when I started writing 20 years ago or more, scientists would not touch that question. To do so would be an embarrassment, overreaching, philosophy. Now everybody's asking that question. It's tremendously exciting, but we're still in our infancy in our ability to formulate an answer. So in a way the question is still philosophy but it's undergirded now by these new kinds of data, imaging data for example, ways into the locked room that didn't exist before. So we're right in between having the question being respectable and having the question being answerable.

SM: You write that "imaging and drugs are opening the locked-room mystery of the mind." But there are issues with all advances, including as Weber worries about, the deterministic view that technology will eventually provide a neurological basis for consciousness. He wants to find more explanation, higher processes, than just interdependent modules making up consciousness. What does his search tell us about the field and about him?

RP: I think it tells us that the field is exploding and it also tells us that the field is incredibly optimistic in a way that it wasn't until recently but, finally, that the field is incredibly messy and a work in progress. Anyone who enters this investigation thinking that we will finally have a complete, simple, reduced, elegant sense of who's driving who around inside the human skull is going to be disappointed. The field continues to point to models that are interdirectional, complicated, richer than we thought. So as always the most interesting research shows us that we have to up the ante with the questions, make the questions more sophisticated, make the questions more open to complexity.

SM: An idea that comes out of the book is that one theory for explaining the basic riddle of conscious existence used to dominate in neuroscience, then another opposing theory took hold, but it seems to say that currently no one theory is dominant.

RP: That would be my guess. As a lay bystander in this, watching the field as someone in the grandstands trying to figure out the rules of the game, I would say the fact that you can have hugely accomplished and masterful scientists at war with each other about their prevailing model leads me to believe that the issues are going to remain complicated for awhile to come and the grand unified sense of consciousness will incorporate all these views in the final model somewhere. The mental network, when we learn how to think and talk clearly about it, is not going to be dominated by any simple mechanism. It's going to be a hybridized and aggregate view that partakes of many positions that the field has embraced. These countervaling ways of looking at what's going on inside the brain are going to have to be integrated in some way.

In some ways the book is about empathy. It's about whether it's possible for any of us to know what it would feel like to be someone else, or something else. In what way does the self blind us to the realities of other people and our dependence on them?

SM: In *The Echo Maker* the connections that tie us most intimately to our worlds are called into question. Every character in the book has some broken link: Mark, whose closest ties in the world – his sister, his dog, even his house – have no emotional connection for him because of Capgras syndrome; his friend Bonnie questions religion because neuroscientists showed that stimulating a certain region of the brain can produce religious-type effects like out-of-body experiences; Weber has doubts about his past neuroscience work that make him feel disconnected. Man as a species seems to require those family and social connections, but neuroscience tells us it's all a construct. So how would you reconcile the "illusion of solidity" that Weber talks about with living a whole, integrated life?

RP: In some ways the book is about empathy. It's about whether it's possible for any of us to know what it would feel like to be someone else, or something else. In what way does the self blind us to the realities of other people and our dependence on them? Part of what neuroscience has been saying in recent years is that the self is messy and aggregate and improvised and made up of all these multiple parts. The feeling of continuity and recognizability and consistency may be a story, it may be something of a narrative. On the one hand that's a terrifying thing. The more that we look under the hood and see that we aren't what we feel that we are, the more destabilizing and de-centering it is to continue to be alive. And science has always done that to us, right? It's always taking a hard look at the story that we're telling about who we are and saying, let's think about this again. So, yes, neuroscience is just the latest blow to our narrative of self. On the other hand, there are things that are coming out of neuroscience now that give us our first glimpse of how the brain itself makes empathy and how our individual selves are actually quite dependent on our connections to other people. How memory is a collaborative phenomenon and how mirror neurons inside our brain are actually simulating and recreating other people. When I see someone smile it causes a kind of sympathetic circuit, a recapitulation of that smile inside me and a simulation of the mind of that other person. So there are possibilities coming out of the new neuroscience that suggest maybe this destabilization of the old monolithic ego-centered self isn't such a bad thing and may be making us more aware of the ways in which we are collaborations or nodes in a network and that our selves don't end so violently with the limits of our skin, but that they are actually produced in concert with other people. Maybe that's quite a wonderful and liberating and an encouraging position for us as social beings.

SM: Would someone like the character Bonnie be comforted by that?

RP: No, but it's absolutely true that science can't proceed according to whether or not the data is comforting. It's up to us to revise our story in a way that still makes it palatable to ourselves and yet accepts the repeatable and demonstrable phenomenon.

SM: You write in *The Echo Maker* that because of knowledge advancements in neuroscience, cognition is heading toward grasping itself and wonder what that would mean for us as a species. If that ever did become reality, what do you think that would mean for people? Would that be a tipping point?

RP: Yeah, I think it is. I think that process is very slow and fitful and gradual and qualified. In fact, when you describe that process, it's the same process that we've been undertaking since the beginning of the scientific revolution. This slow and steady revising of our official narrative answer to who are we and what are we doing resembles in a macrocosm the constant checks to an individual's self-narration: who are you and what are you trying

to do. Every day presents us with challenges to our official self-narrative. We revise and we improvise and we carry on. The sense of human culture and human society has changed so profoundly since Copernicus said we're not at the center of the universe. We've been constantly demoted from our human-centric vision. In a sense these new views of the mind and the self can be seen as the latest challenges. But I think it's wrong to think of science as diminution of the story of what it means to be human. In fact, looked at in the way most scientists look at it and the way that the educated lay person looks at it, the challenges that science has presented to our official self-images, have actually been incredibly enriching. The smallest things in us that we take for granted are miracles. Science has intensified our awe and wonder at who we are and how we got here. I think, for instance, to bring it right into the central arena that America is fighting over right now, evolution as a story is far more staggering and full of amazement and much grander than creationism. Looked at carefully and soberly, evolution hugely increases our astonishment at the mere existence of humans. However much of a shock it is to put aside old stories, the new stories can be full of greater possibility. I tend to be a guarded optimist in general and my books tend to try to find some way of affirming the human story. There's no question that this upheaval of science is extremely painful and volatile. We're witnessing now in the last six years a retrenchment on the part of society toward funding science, toward supporting science, toward teaching science, toward *believing* in science. Preserving scientific advance is not going to be easy. In fact, today we're in great danger of going backward. It's going to take a lot of people, scientists and humanists alike, to say we don't want to go backwards, we don't want darkness, we want more light on things. We want to convey the astonishment and awe and new sources of meaning that these new discoveries are creating. When the right attacks science as somehow a threat to family values or the sanctity of life, it's out of ignorance. When the left attacks science as some corporate-driven hegemonic threat to equality, it's doing so out of ignorance. Scientists need to realize that part of the job of science is bringing that data back into a palpable new vision of social humanity. Our future is also going to depend on the humanists, who right now are often suspicious and terrified of science, to embrace and to understand and to narrate and to celebrate, and also to interrogate and to question and understand in every possible way, the things that are coming out of the lab. I can see us living in a very fitful relationship to science and technology indefinitely. But I can also see us gradually coming to terms with and accepting and moving forward these really magnificent new stories of who we are and what we might still do.

SM: You started out at the University of Illinois as a physics major and science infuses most if not all of your writing, so obviously it's an important topic to you. Sometimes people feel threatened by science or believe that they can't understand it, but you share it with them through your novels. Could you make a case for why science is important and should be embraced by all of us?

RP: The case can be made in so many ways. Every aspect of our existence right now, the terms on which we lead our daily lives, result from the changes in the world brought about by science and technology. Our whole contract with time and space is different now and continues to change every year because of scientific and technological developments. So like it or not, who we are reflects and incorporates what we've done in the scientific disciplines. Even the most terrified anti-scientific Luddite in this country is assuming certain things about health and happiness and welfare that have been allowed by these scientific developments. So if the humanist mission is to say who we are and how we got here and where we think we're going, you can't ask those questions without really confronting the single largest consolidated enterprise that we have going on right now, which is collective science. Part of the problem is that in American universities, there is a huge fight for resources. Often there is the perception in the humanities that all the money is being sucked out of the old-style humanistic disciplines. That's going to cause rivalry and turf wars. But I think there are larger issues at stake. If we really want to be true to our disciplines, we have to see how everything connects to everything else. That's where fiction comes in. Science, and to a large extent the humanities, have succeeded by incorporating this model of reductionism where we can understand the whole in terms of the parts. Everybody has their specialization and moves ahead controlling the variables, and simplifying and talking about individual things in isolation. The arts are one of the few places where you can still think holistically and ask: how does everything connect to everything else, and what happens when complicated people, each of whom is living these separate existences, have to get together in the same room and talk to each other.

That's what I would like to do inside novels. Literature is a way of voicing different worldviews and making them bump up against each other, seeing what kinds of new perspectives arise when we're not allowed to dictate the world entirely through our unique views. It's a place for showing multiplicity and diversity of viewpoints and connectivity. Inside a rich story the smallest ripple in one person's world is going to have consequences in another – which is also true in life, but often we're not allowed to talk about that inside our specialties.

It's going to take a lot of people, scientists and humanists alike, to say we don't want to go backwards, we don't want darkness, we want more light on things. We want to convey the astonishment and awe and new sources of meaning that these new discoveries are creating.

SM: The characters of Mark and Weber are captured very well even though they come from very different social strata and, except for Weber in some ways, different backgrounds than your own. How do their social differences fit into the themes of the book?

RP: The book shows how each of us is this complex multiple performance. We act as different people with different people. We're constantly improvising new selves in the presence of others. But that's only appropriate, given the things that neuroscience is telling us. If the self is this kind of core-making storyteller for these hundreds of distributed systems inside the brain, is it any surprise that each of us socially is also this kind of core-making storyteller for all the different ways we have to be in the world?

The Echo Maker is published by Farrar, Straus and Giroux and is available at their Web site (http://www.fsgbooks.com/) as well as bookstores.

SYNERGY is a quarterly publication of the External Relations office of the Beckman Institute for Advanced Science and Technology at the University of Illinois at Urbana-Champaign. Each issue will spotlight the people and science that make the Institute one of the premier facilities for interdisciplinary research in the world.

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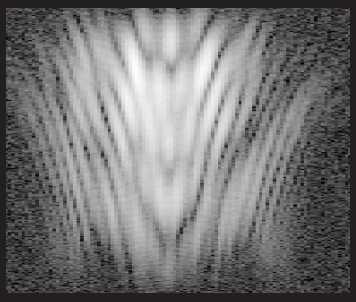
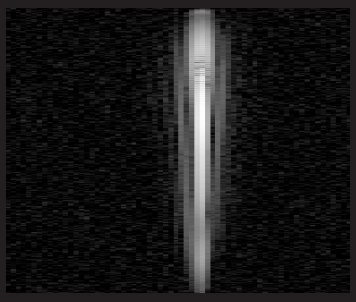
Research spotlight increasingly falls on bioimaging

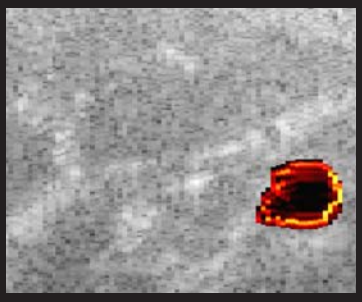
When the call went out last year for seed proposals aimed at developing a possible new research initiative at the Beckman Institute, three of the 11 proposals selected for funding involved biological imaging.

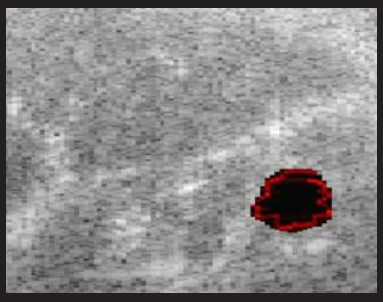
A long list of Beckman faculty members and colleagues from outside the Institute proposed projects that involve using bioimaging for advancing medical research in the areas of breast cancer, speech birth defects, and targeted delivery of drugs and other agents at the molecular level.

The growing interest in bioimaging and biological engineering for medical and other scientific uses can be measured by the goals of funding agencies and through the use of various imaging modalities, including magnetic resonance imaging, optical imaging, and ultrasound imaging by researchers from an increasing number of disciplines. The









magnets at Beckman's own Biomedical Imaging Center, for example, have been used in expected ways such as neuroscientists imaging the brain, and in surprising fashion, like engineers imaging microfluidic flow. Bioimaging is one of four cornerstone research lines at the recently created Department of Bioengineering at the University of Illinois at Urbana-Champaign.

If a new Beckman Institute research initiative were added within the near future, bioimaging would seem to be a likely candidate. Beckman Director Pierre Wiltzius said discussion of a new research initiative is still a few months off, but added that bioimaging would be a natural fit.

"For the Beckman Institute this is a very natural area for us to be in because that is the interface where we want to be at, between the physical sciences and the life sciences, biological sciences, and social sciences," Wiltzius said. "Where it gets interesting in the context of the Beckman Institute being driven by interdisciplinary research is that bioimaging in itself can also be interdisciplinary, or multimodal, with many different techniques applied at the same time. That is something that is very much by nature a Beckman-like topic."

Wiltzius said there are a couple of reasons for the emergence of bioimaging as a field of study.

"I think generally there is a lot of emphasis on bioimaging. In optical imaging this is indeed driven by technological advances that come all the way from new infrared light sources invented in the telecommunications industry and new detectors, signal processing and so on," he said. "The other reason is that as a lot of these tools have been developed in the physical sciences and engineering, they do find new applications in the life sciences and biological sciences."

Beckman faculty member Michael Insana is playing a leading role in bioimaging developments at the University of Illinois and at the Institute. Insana, who was chosen to head the new Bioimaging Science and Technology group at Beckman, is co-author of one of the seed proposals and is a faculty member in the Department of Bioengineering.

Insana said a possible research initiative centered on bioimaging would complement a broader push to integrate bioimaging theory and research with real-world applications.

"From my point of view in bioengineering we're trying to put together a new department," Insana said. "How are we going to be able to compete with people like Duke and Johns Hopkins, and other places with strong medical schools? The things we thought about focusing on were really important and interesting problems in the biological sciences for which new technologies can be applied. The area that I, and many of us in this group, have been funded to work on is cancer."

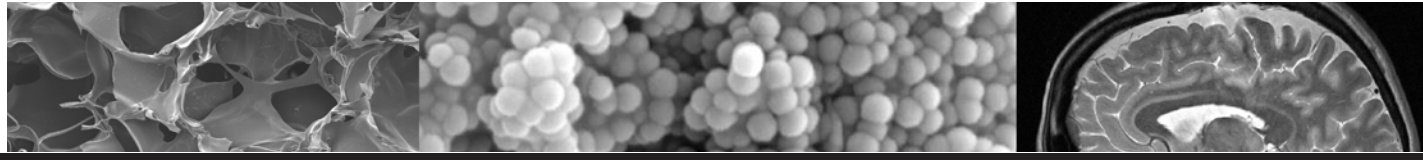
The seed proposal from Insana and four other Beckman collaborators – Thomas Huang, Zhi-Pei Liang, Stephen Boppart, and Rohit Bhargava – is for developing molecular imaging technologies for imaging breast cancer.

Carle Hospital in Urbana is dedicating an entire floor of its new Mills Breast Cancer Institute, set to open in 2008, to research by scientists associated with the University of Illinois. Insana said his group hopes to be a part of this new facility for fighting cancer.

"We're thinking how is it we can develop our science and technology with the eventual goal of perhaps interfacing with them," Insana said. "That's the context in which we're building."

Boppart, who has been working on using optical coherence tomography as a non-invasive or minimally invasive method for detecting breast cancer, has already located his new imaging equipment at Carle and conducted trials there. A current focus of Insana's Ultrasonic Imaging Laboratory is on the elasticity of cancer tissue. Liang has worked on improving MRI techniques for better detection of cancer. Along with Huang's expertise in image analysis and Bhargava's knowledge of imaging tools and cancer pathology, the group looks to have all the components to succeed in its goal of developing new and comprehensive methods to fight breast cancer.

"What we're hoping to do is to study certain aspects of the problem from the tiniest scale all the way up to the very largest scale," Insana said. "So each of our technologies in this group looks at a different aspect of breast cancer. There really isn't someone who has put all this together to come up with a fairly comprehensive view of what's going on in the progression of cancer as it transforms into a metastatic process. What we're trying to do with that particular



"We will be collaborating in strategic areas ... we will certainly be broader in terms of our imaging activities, particularly when it comes to neuroimaging."

– Pierre Wiltzius, Director, Beckman Institute

process is eventually feed it into a model of how cancer is formed and progresses."

Wiltzius said the collaboration with Carle is exciting, but this research line will go beyond any one project.

"We will be collaborating in strategic areas with Carle and the new breast cancer institute," Wiltzius said. "But it will be well beyond that. We'll collaborate where it makes sense but we will certainly be broader in terms of our imaging activities, particularly when it comes to neuroimaging."

Imaging of the brain has been a key component for Beckman psychology researchers for many years, but improving techniques and developing new imaging modalities is a goal for both neuroscientists and engineers. Brad Sutton, a member of the BST group and an assistant professor in the Bioengineering Department, was the chief engineer for BIC's 3Tesla headscanning magnet used for neuroimaging. Part of Sutton's research is geared toward improving MRI signal processing for brain scans.

In addition, neuroscientists at Beckman are developing their own imaging techniques. Kara Federmeier uses an electrophysiological cap developed at her laboratory to measure event-related brain potentials (ERPs) that are used to gauge how the brain reacts to certain stimuli. Gabriele Gratton and Monica Fabiani, directors of the Cognitive Neuroimaging Laboratory, have developed a system called EROS (Event-Related Optical Signal) that uses light and optic fiber bundle detectors for dynamic imaging of brain activity. Fellow Cognitive Neuroscience group member Denise Park and BIC director Art Kramer use the 3T magnet for both MRI and functional MRI studies of the brain.

The Environmental Scanning Electron Microscope of Beckman's Imaging Technology Group (ITG) is used by both researchers in the life sciences and students involved in ITG's Bugscope program to view cells without completely dehydrating them. ITG also features a micro-CT scanner useful for bioengineers interested in imaging bone structure.

The funding is following the bioimaging trend. In August, the National Institutes of Health's National Center for Research Resources announced High-End Instrumentation (HEI) grants totaling $21.5 million so research facilities could acquire cutting-edge imaging equipment such as MRI and computed tomography technology for "advancing biomedical research and increasing knowledge of the underlying causes of human disease." Industry is joining the governmental and academic push to take advantage of emerging bioimaging and bioengineering breakthroughs.

Insana said that researchers from large pharmaceutical companies to universities are incorporating bioimaging and bioengineering into their thinking when it comes to drug discovery and delivery and the development of cutting edge biological treatments to develop and test new methods and treatments. He said researchers envision using imaging to custom design for a particular disease process, for example, and then test for reactions to a targeted drug delivery method for treating that disease.

"Imaging is a way to do this without the expensive, time-consuming (methods of the past)," Insana said. "Imaging can look at a smaller group of animals and watch them progress over time."

Insana added that most imaging techniques are non-invasive and non-destructive, so studies can be done with living organisms without perturbing the system. Researchers are also developing ways to deliver drugs at the same time they are imaging a system. Imaging is also playing a role in functional genomics. Insana said researchers in the Bioengineering Department using computational methods employ imaging data to model a phenotype or a cell that expresses diseases such as cancer.

"So a big view of what we're working on is, can we take all of this imaging information and all of these different scales and feed that back into this functional genomic model so we can study not only the DNA component but how the environmental factors, things like hormones, other metabolic factors, feed back and maybe influence the way the genome influences the disease and progresses," Insana said. "Then maybe we can get a pretty good idea about why cancer is so different in so many different patients."

The Bioengineering Department is so new that it only began accepting graduate students in 2004. Beckman faculty members make up most of the department's faculty. Bruce Wheeler, leader of Beckman's NeuroTech group, is interim head of the department, while Beckman researchers Yingxiao Wang, Sutton, Bhargava, and Insana are professors in Bioengineering.

"We sort of revamped the entire process with a couple of principles in mind, which I found quite exciting," Insana said of the department. "If you're in, say electrical engineering, you know exactly what your undergrads coming in have in terms of their core courses. In bioengineering we take people from biology, chemistry, all kinds of places. So our challenge is to try to get them up to speed very quickly so they can become productive, and yet still maintain some sort of a base knowledge. That's essentially what a discipline is. We had to generate a discipline."

At Beckman, the Bioimaging Science and Technology group Insana heads includes Sutton, Bhargava, and Wang, but also has researchers like Boppart, whose focus is on biophotonics, and Kenneth Suslick from the Chemistry Department. This interdisciplinary approach and improvements in imaging technology offer a powerful combination for advancing medical research.

"In each of these imaging modalities the sensors are getting much more sensitive, broader band, so we're delivering much higher quality images," Insana said. "But at the same time we're starting to understand how these radiation systems are interacting with the body.

"We're bringing chemists into the imaging realm and these chemists are developing probes – meaning little tiny molecules – that are very novel and able to deliver a contrast media to various areas. So this is bringing together people from chemical engineering who are doing drug delivery that are interested in bringing drugs into these probes, chemists who are interested in how to attach a sensitive molecule to a vehicle, and imaging people who are really interested in how to tune their systems to be very, very sensitive to these probes without disturbing them."

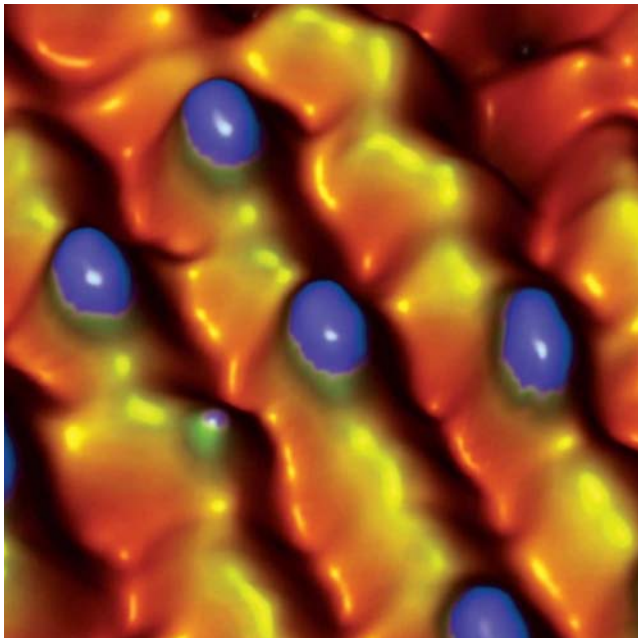
Insana came here in 2005 after serving as head of the graduate program in the Bioengineering Department at California-Davis. He was drawn by the reputation of the U of I's College of Engineering, the chance to help build a new department at Illinois, and by the opportunities offered for collaborations and new research at Beckman.

"It's the No. 4-ranked engineering college and the kinds of things that I do are really related to electrical engineering for imaging and biology," Insana said. "More recently I'm moving into materials science and mechanical engineering, so it's very, very interdisciplinary. When I saw what Beckman does, the fact they can take people from all these different disciplines and put them together, it was just a wonderful place and it's been that way for me."

Hersam Values Lessons Learned at Beckman

Up and Coming Researcher Touts Interdisciplinary Approach

Mark Hersam



This figure contains a scanning tunneling microscopy image of individual cyclopentene molecules on a silicon surface taken at a temperature of 80 K.

Reference: N. P. Guisinger, N. L. Yoder, and M. C. Hersam, "Probing charge transport at the single molecule level on silicon using cryogenic ultra-high vacuum scanning tunneling microscopy," Proc. Nat. Acad. Sci. USA, 102, 8838 (2005).

What does a researcher with a Ph.D. in electrical engineering do when confronted with one of the biggest challenges facing carbon nanotube technology? Mark Hersam's experience at the Beckman Institute told him to look outside the materials science box and try something from the biochemistry labs.

Carbon nanotubes have been touted for years as one of the next great technological breakthroughs for everything from electronics to sensors, but their properties make them difficult to control and, therefore, produce on a large scale.

"Carbon nanotubes, due to a lack of uniformity in their physical and electronic structures, are not suitable for large-scale production in most technologies," said Hersam, a professor of Materials Science and Engineering at Northwestern University. "So we've recently developed a strategy for sorting carbon nanotubes by their diameter and electronic properties."

Hersam used a technique in biochemistry called density gradient ultracentrifugation, calling upon a centrifuge to sort the nanotubes by their diameter and electronic properties.

"What we recognized is that carbon nanotubes, as a function of their diameter, will have subtle differences in their buoyant densities, that is their mass per volume," Hersam said. "As a result, if you can come up with a way of sorting nanotubes by their density, then you should be able to sort them by their structure and properties. As it turns out, there was already a strategy in biochemistry that allows separation by density.

"This work is an excellent example of how my interdisciplinary training at Beckman taught me to look outside of my discipline when faced with a challenging problem. In this case, when faced with a problem in electronics and materials science, we went to biochemistry to find a solution."

Hersam is just six years removed from a Ph.D. in electrical engineering from the University of Illinois at Urbana-Champaign, but he already has his own research group at Northwestern, a solid line of papers in peer-reviewed journals, and two of the most coveted awards any young researcher can win. Last year, Hersam was given a Sloan Fellowship and in July of 2006 he was honored at the White House with the 2005 Presidential Early Career Award for Scientists and Engineers.

A native of Downers Grove, Hersam earned a B.S. in electrical engineering from the U. of I. and a Master's in physics from Cambridge in England. As an undergraduate and as a graduate student, Hersam did research at Beckman, working with Joe Lyding in the Molecular and Electronic Nanostructures research initiative. Lyding, who built the first scanning tunneling microscope (STM) at Illinois, was a mentor for Hersam, and they collaborated on research projects and papers involving subjects such as atomic level manipulation and silicon-based molecular nanotechnology.

Hersam took his STM expertise and research interests to Northwestern in 2000 when he joined the faculty there. He also brought along an approach to research that was ingrained during his time at Beckman.

"The number one thing that I learned at Beckman is how to interact in an interdisciplinary environment," Hersam said. "The idea of Beckman really works, all the way down to the student level. At a lot of places faculty may interact with each other but students keep to their own research group.

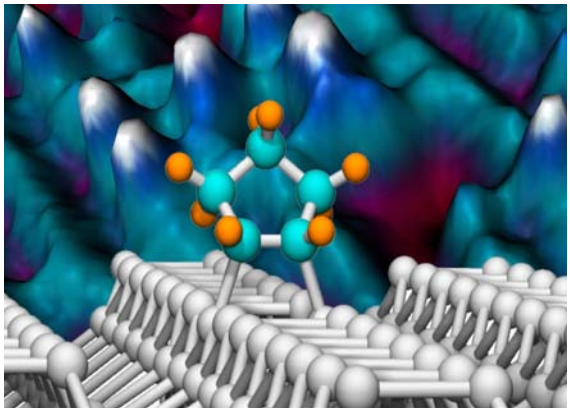
"But at Beckman the students really interacted. That allowed me to understand how interdisciplinary

research works and also learn many of the skills and techniques not only in my field, but also in other fields. Since becoming a faculty member at Northwestern, I've been successful in establishing interdisciplinary research programs as a direct result of my time at Beckman."

At Northwestern, STM technology has remained an important part of Hersam's work. He currently is using scanning tunneling microscopy to probe the electrical properties of organic molecules on silicon surfaces. Improving the performance of electronics at the level of individual molecules is the long-range goal. Hersam said that Intel Corporation is currently working on transistors at the scale of about 100 nanometers, but the ultimate goal is to get down to the molecular scale, or about one nanometer.

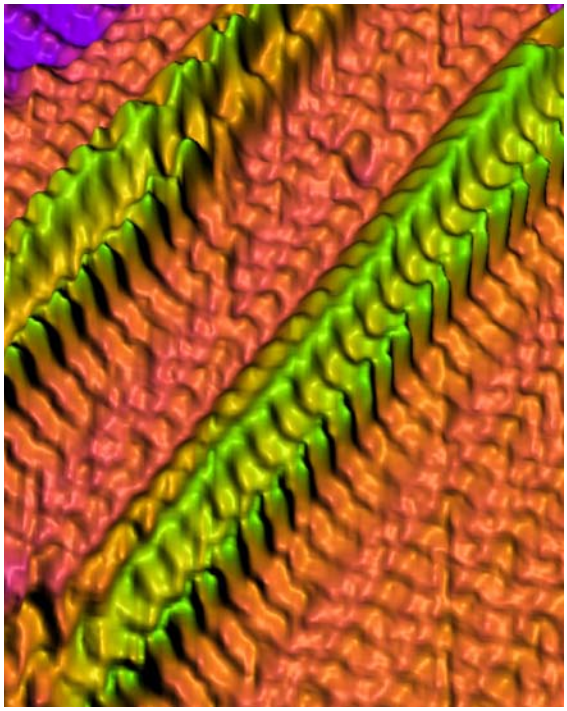
"We are exploring what could happen in future electronic technologies," Hersam said. "If you look at the trends in microelectronics you're looking at 20 or maybe even 30 years in the future where, if things continue at the same rate as today, you would have devices made at the molecular length scale in industry.

"That's a long way off; this is very long-term research. But with the scanning tunneling microscope we can begin to probe how such devices work and if it is worth continuing electronic miniaturization all the way down to the single molecule level. We may find that electronics cannot be pursued as we know it at this length scale or that there are some fatal flaws to molecular electronic technology. However, at this point, it looks promising enough to continue our research."



This figure contains a three-dimensional rendering of an ultra-high vacuum scanning tunneling microscope image of individual cyclopentene molecules on a Si(100) surface. The foreground contains a ball and stick model of the experimental data.

Reference: N. P. Guisinger, R. Basu, M. E. Greene, A. S. Baluch, and M. C. Hersam, "Observed suppression of room temperature negative differential resistance in organic monolayers on Si(100)," Nanotechnology, 15, S452 (2004).



This figure is an atomic resolution ultra-high vacuum scanning tunneling microscopy image of one-dimensional styrene molecular chains on a hydrogen passivated Si(100) surface. The apparent width of the styrene molecular chains is approximately 1 nanometer.

Reference: R. Basu, N. P. Guisinger, M. E. Greene, and M. C. Hersam, "Room temperature nanofabrication of atomically registered heteromolecular organosilicon nanostructures using multi-step feedback controlled lithography," Appl. Phys. Lett., 85, 2619 (2004).

The work with carbon nanotubes is another current focus for Hersam. In the October issue of *Nature Nanotechnology,* Hersam and his collaborators reported original research using density gradient ultracentrifugation for sorting nanotubes by their density.

"One advantage of this technique is that it is fully scalable," Hersam said. "If you look at industry today, for example the pharmaceutical industry, you can find large-scale centrifuges that continuously handle hundreds of liters of solution at a time. With this technology, we anticipate that our process can be scaled up to provide large quantities of purified carbon nanotubes."

Hersam's research has already made an impact, as evidenced by the papers and awards. The Sloan Research Fellowship from the Alfred P. Sloan Foundation is the oldest and one of the most prestigious fellows program in the country. He said the Presidential Early Career Achievement Award was special because researchers from all the sciences are eligible for it. Hersam was also impressed that President Bush took time out of his busy schedule to attend the event.

"President Bush made the time, which was surprising because on that day he had to meet with the Iraqi Prime Minister," Hersam said. "I think it would have been easy and understandable for him not to attend. His attendance showed his support of scientific research and education."

Hersam appreciates his Teacher of the Year Award from Northwestern's Department of Materials Science and Engineering as much as any of his honors.

"The teaching award is very meaningful to me. I became a professor first and foremost to educate and the teaching award was granted by the students," Hersam said.

For anyone thinking about pursuing a career in academia, Hersam has a couple of pieces of advice. He said keeping an open mind is crucial for any person interested in an academic career of teaching and research — and the Beckman Institute is an excellent place to develop that mindset.

"Being in an environment like Beckman is perfect because you can be exposed to a wide range of topics, not just what is going on in your particular research group," he said. "I think that's critical for many reasons, one being that most of the interesting problems in research today are at the boundaries between disciplines."

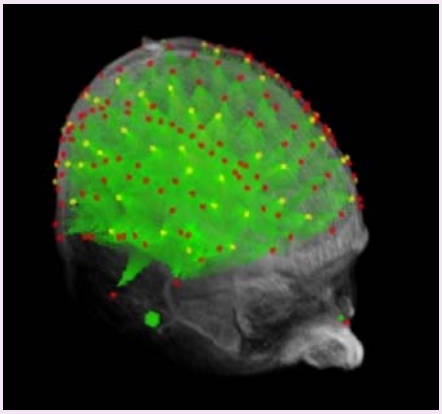
Hersam added that having a wider range of interests also helps when it comes to securing funding for research proposals.

"If you have a broad training, then you can diversify your research program and be less sensitive to the winds of change in Washington," Hersam said. "The second piece of advice, which is true not only in academia, but true for any career in science, is to become as efficient as possible in your work.

"Everyone at this level is putting in the maximum number of hours, so there's no way that you can outwork anyone. The only way you can be more productive is to be more efficient and make good decisions regarding how to spend your time."

Honors & Awards

Fabiani, Federmeier honored by Society for Psychophysiological Research



The University of Illinois at Urbana-Champaign has long played an important role in the Society for Psychophysiological Research, considered one of the top professional organizations in the field of psychology, and researchers from the Beckman Institute are carrying on that tradition. **Monica Fabiani,** Co-chair of Beckman's Biological Intelligence research initiative, was elected President of the Society for Psychophysiological Research at the organization's meeting Oct. 25-29 in Vancouver, Canada.

Fabiani joins a number of other University of Illinois faculty members who have earned this distinction, including Beckman researcher Gregory Miller. "Monica's election is particularly impressive because it has come at a relatively young age, which reflects how widely recognized and respected her work has been," Miller said. "This is a great honor for Monica, the Department of Psychology, the Neuroscience Program, the Beckman Institute, including its Biomedical Imaging Center, and the campus."

Miller said Illinois has contributed more presidents than any other university to the 46-year-old Society, which he said is "the most prominent in the world in psychophysiology and highly respected across the whole range of psychology."

Fabiani is co-director with Gabriele Gratton of the Cognitive Neuroimaging Laboratory. Their research focuses on the cognitive neuroscience of human memory and aging, while developing tools for the non-invasive mapping of human brain function.

Earlier this year **Kara Federmeier** was honored with the 2006 Distinguished Scientific Award for Early Career Contribution to Psychophysiology by the Society. Federmeier is director of the Cognition and Brain Laboratory at Beckman. Her research focuses on how people communicate meaning and comprehend language.

Fellow Beckman researcher **Denise Park** was the featured speaker at a panel discussion on women in science at the Society for Psychophysiological Research meeting, discussing experiences unique to women in science and academia based on the research literature. Federmeier, Park, and Fabiani are all members of the Institute's Cognitive Neuroscience group.

Huang earns IBM Award

Beckman researcher **Thomas Huang** has been chosen for an IBM Faculty Award for 2006. Huang is Co-chair of the Human-Computer Intelligent Interaction research initiative.

Dr. Huang received the IBM Faculty Award for a project titled "Audio-Visual Recognition of Human Emotional and Cognitive States" which aims to provide real-time, robust algorithms for applications such as computer-aided learning, smart kiosks, electronic games, and automobiles.

The IBM faculty awards program honors researchers worldwide in its goal of fostering collaboration between researchers at leading universities worldwide and those in IBM research, development and services organizations. It seeks to promote courseware and curriculum innovation to stimulate growth in disciplines and geographies that are strategic to IBM. Candidates for the award must be nominated by an IBM employee with common interests who will serve as a liaison for the collaboration. Huang's research interests at Beckman focus on topics such as multimodal human-computer interfaces, multimedia databases, and image processing.

Park Headlines Surgeon General's Workshop on Health Literacy

Beckman Institute researcher **Denise Park** was a featured panelist on the Surgeon General's Workshop on Improving Health Literacy held Thursday at the National Institutes of Health in September.

Park was a panelist for a discussion on "Meeting the Health Literacy Needs of Special Populations."

Park, Co-director of the Center for Healthy Minds at the Beckman Institute, continues to be a resource for United States government officials concerned with the nation's health. Last year Park testified before a United States Senate committee investigating fraud against the elderly, sharing her insights into why older adults are more susceptible to scams. Recently, Park was awarded a 10-year, $5 million MERIT award from the NIH's National Institute on Aging for a landmark study that will focus on cognition in middle-aged adults.

Nancy Sottos to be named SES Fellow

Molecular and Electronic Nanostructures Co-chair **Nancy Sottos** was named a Fellow of the Society of Engineering Science. The honor is for her distinction in the field of Engineering Science and her contributions to the Society.

Sottos will receive the award during the 44th Annual Technical Meeting of the Society of Engineering Science, October 21-24, 2007, at Texas A&M University, College Station, Texas.

Sottos, a member of Beckman's Autonomous Materials Systems group, is a Donald Biggar Willett Professor of Engineering in the Department of Materials Science and Engineering.

Her research focus at Beckman centers on development of autonomic materials systems that have the ability to adapt to and respond in an independent and automatic fashion to cracks and other materials failures. Sottos is part of the Beckman team that was awarded a $5M grant last year from the Air Force Office of Scientific Research for the development of Microvascular Autonomic Composites.

Two ITG entries finalists in MRS Scientific Film Festival

Beckman's **Imaging Technology Group** has two out of the six finalists for top honors in the inaugural Materials Research Society "Scientific Film Festival."

The Festival will take place at the MRS Fall 2006 meeting in Boston Nov. 27-30. Conference attendees will get to vote for the top science films and a panel will then choose from the top vote getters. Prizes will be awarded for the three best films in both the professional and amateur categories and will be awarded during the Symposium X session of the conference.

One of the two ITG entries is about **Scott White's** work with self-healing materials. The other was made with **John Rogers** for the Tech Museum in San Jose about his research into stretchable silicon. White and Rogers are members of Beckman's Molecular and Electronic Nanostructures research initiative.

Large grant awarded for new MEMS/NEMS Center

Beckman researcher **Andreas Cangellaris** is the principal investigator on a multi-university grant award of $4.5M toward the development of a new center advancing research in the area of micro-scale and nanoscale electromechanical systems (MEMS and NEMS). The proposal is for the establishment of IMPACT - Center for the Advancement of MEMS/NEMS VLSI.

The multi-university proposal included a lead group from the University of Illinois at Urbana-Champaign that features Cangellaris, and fellow Beckman researchers **Narayana Aluru, Philippe Geubelle, Ioannis Chasiotis,** and **Umberto Ravaioli.** The other universities involved in the award are Purdue, Georgia Institute of Technology, and Lehigh, as well as industrial partner MEMtronics. The $4.5M grant from the Microsystems Technology Office (MTO) of DARPA is for six years.

The goal of the Center is to develop the physics-based knowledge needed to enhance the lifetime performance and functionality of highly integrated MEMS/NEMS-based micro- and nano-systems for commercial and military systems.

Anderson named Boss of the Year

Beckman Institute Associate Director **Van Anderson** has been named 2006 Boss of the Year by Secretariat, a University of Illinois organization of supervisory level employees.

Anderson was nominated by Cathy Rix, assistant program administrator at Beckman.

A SAMPLING OF BECKMAN INSTITUTE RESEARCH RECEIVING NATIONAL MEDIA ATTENTION:

DETECTING COCAINE

November 14, 2006 — Researchers at Illinois led by Beckman researcher and U. of I. chemistry professor Yi Lu, have developed a simple "dipstick" test for detecting cocaine and other drugs in saliva, urine or blood serum. The test is based upon DNA-gold nanoparticle technology, and can be packaged in user-friendly kits similar to those used for home pregnancy tests.

Nanotechwire.com

METALLIC SINGLE-WALLED CARBON NANOTUBES

November 14, 2006 — Metallic single-walled carbon nanotubes can be selectively etched and eliminated from a substrate without damaging their semiconducting single-walled nanotube neighbors, thanks to a finely tuned methane plasma reaction process developed by scientists at Stanford University. "The technique is important, in part, because it has the potential to advance efforts that seek to use dense, aligned arrays of nanotubes as effective thin-film semiconductors for scalable, ultra-high-performance electronics," says John Rogers, Beckman researcher and chemistry professor at Illinois.

Chemical & Engineering News

GLOWING SUGAR

November 09, 2006 — As reported in today's issue of *Nature* (Nov. 9), Beckman researcher and U. of I. chemistry professor Kenneth S. Suslick and graduate student Nathan C. Eddingsaas have used high-intensity ultrasound in liquid slurries of sugar and other organic crystals to create mechanoluminescence up to 1,000 times more intense than can be achieved by grinding.

PhysicsWeb

Multitasking 20-Somethings

November 06, 2006 — The best at switching back and forth between tasks seem to be 20-somethings, based on research at Illinois.

People ages 7 to 82 were asked to switch between two memory tasks in some simple numeric experiments. Both ends of the age spectrum did poorly, with young kids faring worst, says Art Kramer, Beckman researcher and U. of I. professor of psychology.
The Seattle Times

Students Experience Bugscope

November 02, 2006 — Researchers at the Beckman Institute for Advanced Science and Technology at the University of Illinois are using the latest technology to allow students in grades K-12 to explore the furriest, scaliest and slimiest details of those ever-popular creatures: bugs. Bugscope brings kids together with both science and bugs.
The Chattanoogan

Fuel-Cell Engineering

November 02, 2006 — Paul Kenis, Beckman researcher and professor of chemical and biomolecular engineering at Illinois, and colleagues have designed and built ceramic microreactors for the on-site reforming of hydrocarbon fuels, such as propane, into hydrogen for use in fuel cells and other portable power sources.
Chemistry World

Entomology and Genetics

October 31, 2006 — Using a new combination of techniques, Jonathan Sweedler, Beckman researcher and U. of I. chemistry professor and director of the Biotechnology Center at Illinois, and colleagues in Belgium have identified 36 genes that encode brain chemicals likely to play a role in the complex behaviors of the honey bee.
National Science Foundation

Secrets revealed in sequencing of honey bee genome

October 26, 2006 — What do fruit flies, mosquitoes, silk moths and honey bees have in common? First, they are all insects. Second, they have all had their genomes sequenced, a feat that will make it much easier to discern both similarities and differences.
U of I News Bureau

Superconductivity

October 19, 2006 — U. of I. researchers not only have discovered an unusual phenomenon in which ultra-narrow wires show enhanced superconductivity when exposed to strong magnetic fields, they also have developed a theory to explain it. As reported in the Sept. 29 issue of Physical Review Letters, U. of I. physics professor and Beckman affiliate Alexey Bezryadin and his research group have studied the effect of applying a magnetic field to ultra-narrow superconducting wires only a few hundred atoms across, and have used a microscopic theory proposed by physics professor Paul Goldbart and his team to explain the results.
Technology News Daily

Entomology, Agriculture and the Environment

October 19, 2006 — American honeybees, which pollinate more than 90 domestic commercial crops, have declined by 30 percent in the last 20 years. U.S. farmers had to import honeybees last year for the first time since 1922, underscoring the extent of the problem, says Gene Robinson, Beckman affiliate and a U. of I. professor of entomology. "The honeybee industry is at a critical juncture," Robinson said. "The time for action is now."
The Washington Post

Prescribing Exercise

October 18, 2006 — A new study suggests that prescribing exercise may be more effective than simply recommending it. Commenting on the study, William Greenough, a professor at the U. of I.'s Beckman Institute, said vagueness about what exercises should be done limits doctors and patients. With prescription medicines, there's no confusion. "Justice is not being done by just suggesting exercise and not saying how to do it," he said.
United Press International

Exercise and Aging

October 16, 2006 — In terms of physical activity, you don't need to be a triathlete to reap the benefits of exercise, says Arthur Kramer, Beckman researcher and a professor of psychology at Illinois. Kramer and his colleagues have found evidence that modest aerobic exercise in older adults boosts the efficiency of the frontal cortex, a brain region important for multi-tasking, planning and other high-level cognitive functions.
Los Angeles Times

Polarized, Self-Assembling Particles Made

October 13, 2006 — U. of I. scientists have created polarized, spherical particles that self-assemble into clusters with specific shapes and distributions of electric charge. The researchers say the polarized particles can be used in the directional self-assembly of intricate shapes and unique structures. "The world abounds with particles that have traditionally been treated as geometrically symmetric, chemically isotropic and electrically uniform," says Steve Granick, a Beckman affiliate and U. of I. professor of materials science and engineering, chemistry and physics. "We have muddied the waters a bit by asking: 'What happens when we build clusters from particles that have an uneven distribution of electric charge?' "
ScienceDaily

The Echo Maker

October 13, 2006 — If the term "science fiction" had no prior meaning, it would describe all the novels of Richard Powers. The MacArthur "genius"-grant winner, whose ninth novel, The Echo Maker, comes out this fall (and is nominated for a National Book Award), does not just write about scientists, programmers, and engineers, though such professions populate most of his books.
Slate

Bugscope

October 06, 2006 — Fourth grade students at Derby Academy in Hingham, Mass., are using Bugscope, a computer software created by Illinois's Beckman Institute that allows participants to communicate with an environmental scanning electron microscope by means of a remote computer.
The Hingham Journal

The Echo Maker

October 02, 2006 — If you simply rely on the superficial in evaluating writer Richard Powers, you might be baffled by what appear to be contradictions. Powers, a Beckman affiliate and the author of eight critically acclaimed novels that often examine how we respond to the soul-numbing technological changes that surround us, rides a bicycle to his campus office.
Chicago Sun-Times

Cellular Science

September 29, 2006 — Klaus Schulten, Beckman researcher and head of the Theoretical and Computational Biophysics group at Illinois, says the University of Texas's new supercomputer will help researchers better understand how cells work, how viruses infect human cells and how proteins fight obesity within cells.

Austin American-Statesman

Nanolithography

September 29, 2006 — Northwestern University scientists have created 55,000 images of Thomas Jefferson and put them into a space the size of a nickel. It demonstrates the commercial viability of dip pen nanolithography, a technology discovered and pioneered at Northwestern. Beckman researcher and U. of I. electrical and computer engineering professor Chang Liu is among the authors of a paper presenting the work, which was published online Monday by the journal Angewandte Chemie.

Photonics.com

Games Get Serious

September 25, 2006 — U. of I. molecular researcher Klaus Schulten and his team generate computer simulations of working components of human cells in a process that starts with an expensive supercomputer crunching data about millions of atoms. When it's time to view the resulting interactive molecules interacting, the researchers turn to PCs with relatively inexpensive video cards - the same Nvidia and ATI cards that serious game players buy online or off the shelves of electronics stores. "It's been a godsend, a gift to science, to use this," said Schulten, director of the Theoretical and Computational Biophysics group at the Beckman Institute.

San Diego Union-Tribune

Scientists Explain Mechanism in Aquaporins

Sepember 25, 2006 — Using computer simulations and experimental results, researchers at Illinois and the University of Arizona have identified a key component of the gating mechanism in aquaporins that controls both the passage of water and the conduction of ions. "Understanding the molecular mechanism behind gating in membrane channels could lead to more effective protein engineering," said Emad Tajkhorshid, a professor of biochemistry at Illinois and a researcher at the Beckman Institute.

Medical News Today

Computational Biology

September 22, 2006 — In the quarterly publication CTWatch, Eric Jakobsson, Beckman researcher and a U. of I. professor of molecular and integrative biology, discusses the initiatives that will be required between applications scientists and system architects in order to come up with a suitable cyberinfrastructure for biology. One of the five integration models Jakobsson outlines is "integration of algorithmic development with computing architecture design."

HPC Wire

Optical Coherence Tomography

September 22, 2006 — "In the past we were constantly going to telecoms firms to convince them that their products could be useful for OCT (optical coherence tomography)," said Stephen Boppart of the U. of I. Beckman Institute for Advanced Science and Technology. "However, today there has been a switch and photonics companies are now making light sources specifically for OCT."

Optics.org

One protein, two channels: Scientists explain mechanism in aquaporins

September 21, 2006 — Using computer simulations and experimental results, researchers at the University of Illinois at Urbana-Champaign and the University of Arizona have identified a key component of the gating mechanism in aquaporins that controls both the passage of water and the conduction of ions.

U of I News Bureau

Bioengineering

September 20, 2006 — Engineers and biologists have developed the world's first functional artificial hair cell to mimic one of nature's most widespread and versatile data-collecting systems: the lateral lines of fish. In a paper published in an August issue of EURASIP Journal on Applied Signal Processing, engineer Chang Liu, a Beckman researcher and U. of I. professor of electrical and computer engineering, describes how biologically inspired microstructures enable a model fish to locate and track a dipole source.

Science Magazine

Ceramic microreactors developed for on-site hydrogen production

September 20, 2006 — Scientists at the University of Illinois at Urbana-Champaign including Beckman researcher Paul Kenis have designed and built ceramic microreactors for the on-site reforming of hydrocarbon fuels, such as propane, into hydrogen for use in fuel cells and other portable power sources.

UI News Bureau

Habitable Computer

September 19, 2006—In the houses of the future, the walls and windows will, in essence, be computers made of materials, flexible and strong, laced with microelectronics. That's the vision of two Illinois professors: Osman Ataman, a UI architecture and design professor, and John Rogers, a Beckman researcher and professor of materials science and engineering. "You're sort of living in a Pentium," Rogers says.

USA Today

Evolutionary Software

September 18, 2006 — Software designed by Illinois chemist Zaida Luthey-Schulten and her research team at the Beckman Institute is allowing researchers to effectively analyze and compare sequence and structure data of proteins and nucleic acids. "By placing bioinformatics in the context of evolution, we can also perform comparative dynamics studies of proteins from different domains of life," she added.

UI News Bureau

Analytical Chemistry

September 15, 2006 — Jonathan Sweedler, a Beckman researcher and director of the Biotechnology Center at Illinois, is one of 12 scientists who will be recognized by the Pittsburgh Conference for significant contributions in the fields of analytical chemistry and applied spectroscopy. Sweedler will receive the Pittsburgh Analytical Chemistry Award during Pittcon, a symposium held Feb. 25 through March 2, 2007, in Chicago.

Laboratory Talk.com

Detecting Breast Cancer

September 13, 2006 — Researchers at Illinois are developing a near-infrared imaging technique that could significantly affect the ways physicians detect and treat breast cancer. "Tissue removed during biopsy or surgery must be microscopically examined by a pathologist, which can sometimes result in a lengthy and anxious wait for the patient," says Stephen Boppart, a Beckman researcher and professor of electrical and computer engineering, bioengineering, and medicine. "We want to move the microscopic examination of tissue from the pathology lab to the patient's point of care and do the analysis in real time."

United Press International

Healing Wounds

September 13, 2006 — Scientists at Northwestern University have found a way to use nanotechnology to speed wound healing, a process that could someday offer hope to millions of victims of heart attacks and other

major injuries. The findings were reported Tuesday at a semiannual meeting of the American Chemical Society in San Francisco. "It looks like great stuff," says Steven Zimmerman, a Beckman affiliate and chemist at Illinois who helped organize the symposium. One of the Northwestern researchers is Samuel Stupp, who was a chemistry professor at Illinois.
Science

Visually Tasting and Smelling

September 12, 2006 — Beckman researcher and U. of I. chemistry professor Kenneth Suslick has developed a technique that essentially tastes and smells a substance visually. Suslick, who founded the company ChemSensing Inc. in Champaign, Ill., has worked on developing colorimetric arrays for several years. The company's emphasis is on early-stage disease detection, but Suslick has applied the technology to other subjects, including volatile organic compounds and, now, beer. People can smell and taste the difference between beers, and Suslick noted that the colorimetric approach has some advantages when it comes to duplicating that feat.
Photonics Spectra

Bio-Inspired Sensors

September 12, 2006 — Beckman researcher U. of I. electrical and computer engineering professor Chang Liu and University of Virginia professor Joseph Humphrey are collaborating on a project funded by the U.S. Defense Advanced Research Projects Agency to build new bio-inspired sensors.
Daily Progress

Wall Street Journal Technology Innovation Award

September 11, 2006 — Semprius Inc., a start-up based in Chapel Hill, N.C., won a 2006 Wall Street Journal Technology Innovation Award for a process for making large-scale, high-performance electronic circuits that can be applied to any surface. The technology, developed by Beckman researcher and U. of I. materials science and engineering professor John Rogers, the company's president and co-founder, along with a team of researchers at Illinois, does this by using a two-step process: In the first, electronic devices are formed on semiconductor wafer using conventional techniques. Then an extremely thin layer that contains the complete transistor is lifted from the wafer and printed onto the desired material, which can include thin plastic sheets, fabric or rubber
The Wall Street Journal

Fish Navigation

September 08, 2006 — In a paper published in an August issue of EURASIP Journal on Applied Signal Processing, Beckman Researcher and U. of I. engineering professor Chang Liu describes how biologically inspired microstructures enable a model fish to locate and track a dipole source. Real fish use a linear swatch of hair cells on their sides, known as the lateral line, to coordinate group movements, avoid predators, and otherwise navigate.
Science

Hormone-Replacement Therapy

August 31, 2006 — Women pondering hormone-replacement therapy also should consider regular exercise. A new U. of I. study suggests that being physically fit offsets cognitive declines attributed to long-term therapy. "This study not only tells us that there is a benefit to being highly fit, it pinpoints where in the brain it matters for postmenopausal women who have been using the two strategies," said lead author Kirk I. Erickson, a postdoctoral researcher at the Beckman Institute for Advanced Science and Technology at Illinois.
NewsTarget

Jaw-Dropping Speed

August 21, 2006 — A tiny ant has the fastest jaw in the animal kingdom - literally quicker than the blink of an eye. The trap-jaw ant can clamp its mandibles shut at between 125 and 233 kilometers per hour, according to a report in Monday's online edition of Proceedings of the National Academy of Sciences. It can snap its jaws shut with such force that it can propel itself backward out of danger, says co-author Andrew Suarez, a Beckman affiliate and U. of I. entomology professor.
USA Today

Eric Jakobsson on Bioinformatics

August 17, 2006 — Eric Jakobsson, Beckman researcher, U. of I. engineering professor and director of the National Center for the Design of Biomimetic Nanoconductors, spoke at Stanford University this week about the difficulties related to biomedical computation. He discussed how biomedical computing tools are difficult to use and fragile, and they also have limited dissemination possibilities. However, he noted that technology is improving.
The Stanford Daily

Denise Park on Orneriness and Smarts

August 16, 2006 — A recent study from Morgan State University in Baltimore suggests that, after age 60, the most disagreeable people are the smartest. Although she says she doesn't doubt the findings, Beckman researcher and U. of I. psychology professor Denise Park says, "I doubt that being disagreeable is the reason for the higher intelligence." Better educated, wealthier adults, who generally have higher IQs, may not react cheerfully to the patronizing treatment that is often given to the elderly, says Park, an expert on cognitive aging. Such people "have more of a sense of mastery and entitlement. So it could be high ability that's causing their disagreeable quality and not vice versa."
USAToday

Exercise May Slow Impact of Aging

August 11, 2006 — A review of 40 years of data by conducted by Beckman Institute researchers Arthur Kramer, Kirk Erickson and Stanley Colcombe found evidence that exercise may slow age's impact on brain function, helping maintain whip-smart cognitive ability well into the senior years and preventing dementia-like illness.
Forbes HealthDay

Life Cycle of Protein Observed

August 11, 2006 — Using a sensitive, single-molecule measurement technique, U. of I. researchers led by Taekjip Ha, a professor of physics at Illinois and a Beckman Affiliate, have observed the life cycle of RecA, a protein that plays a major role in repairing damaged DNA.
Physics.org

Higher Fitness Levels Benefit Long-Term Hormone Therapy

August 04, 2006 — A U. of I. study suggests that being physically fit offsets cognitive declines attributed to long-term hormone therapy in women. "We found that higher fitness levels enhance the effects of shorter durations of hormone treatment and offset the declines associated with long-term use," said Arthur Kramer, a professor of psychology and researcher at the Beckman Institute.
Xagena

Re-Engineering Milk

August 04, 2006 — Beckman affiliate and U. of I. animal sciences professor Matt Wheeler comments on research at the University of California at Davis involving engineering goat's milk to be more similar to human breast milk. The re-engineered milk has reduced the amount of harmful bacteria in piglet guts. Wheeler says this demonstration of safety and efficacy is the first step before any scientific review boards or the U.S. Food and Drug Administration will allow human consumption of the milk.
ScienceNOW Daily News

Nano-Technique Allows for Refined Patterning

August 01, 2006 — In work at the U. of I., researchers used nanoimprint lithography and carbon nanotubes to replicate features with nanometer dimensions. "We were able to demonstrate reliable patterning at the 2nm scale, and even some capability down to 1nm," said John Rogers, Beckman researcher and professor of materials science and engineering at U of I.
Semiconductor International

Animation Assists Victimized Children

August 01, 2006 — According to Sharon Tettegah, Beckman affiliate and a professor of curriculum and instruction at UIUC, some of the same qualities that make animation work for comedy make it valuable, too, as an outlet for victimized children and for a new research method that tests the empathy of teachers who may deal with them.
Medgadget

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FACULTY PROFILE

Sproat's research path leads from industry to Beckman

Richard Sproat felt energized by the interdisciplinary research environment he found while working at Bell Labs and AT&T Labs. His desire to continue doing research in that type of setting was one reason Sproat came to the Beckman Institute and the University of Illinois in 2003.

"One of the things that was always very nice about Bell Labs—which was quite different from what I knew the case to be in academia—was that I could walk down the hall and talk to an engineer, or a computer scientist or psychologist, all on the same hallway," Sproat said. "You would never get that in a typical academic environment. So one of the things that was so appealing about Beckman is you do have people with all kinds of backgrounds and we really do work together. So it was really the interdisciplinary nature that was the pull here."

What the business world did not quite prepare him for was the juggling act that often comes with being a full-time professor and researcher at a place like Beckman.

"One of the things I have to admit is that when I came to academia I didn't really know what the term busy meant," Sproat said with a laugh. "It's not so much the amount of work; the issue is the number of things that I have to keep juggling at the same time."

A member of Beckman's Artificial Intelligence group who holds faculty appointments in both the Department of Electrical and Computer Engineering and the Department of Linguistics, Sproat has more than a half-dozen current research projects.

Sproat's research interests center on various aspects of speech processing, as well as writing systems, and all of his work has a computational component to it. His interests include such topics as language modeling for colloquial Arabic speech recognition, named entity detection and transliteration for multiple languages, and prediction of prosody from text for affective speech synthesis.

Sproat said the named entity detection project is one of two he is currently spending a lot of his time on. It involves creating software that can pick out the same words or phrases in streams of news texts from varying languages, including ones with completely different scripts such as Chinese and English.

The other key project, funded by a Critical Research Initiative grant from the University of Illinois, is for developing methods for second-language fluency assessment. That project is part of a collaboration with Beckman colleagues Chilin Shih, Kay Bock, Brian Ross, and Mark Hasegawa-Johnson. They are looking at developing ways to assess and improve second-language fluency, an important topic in our increasingly global economy. There is hope the project will lead to a new center on campus for second language learning.

If it happens, the center would truly be interdisciplinary, Sproat said. Bock is a psycholinguistic, Ross is a psychologist, while Hasegawa-Johnson tackles speech issues from an engineering perspective. Sproat said the second language project and a future center would have both research and practical implications that could lead to a quantitative measure of fluency and improve the teaching of second languages.

"There's a whole bunch of issues out there to be investigated," Sproat said. "This center could serve as a test bed for developing these kinds of ideas across the board."