

# SYNERGY

BECKMAN INSTITUTE FOR ADVANCED SCIENCE AND TECHNOLOGY

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**Dan Simons explores meta-cognition and intuitions in his upcoming book**

## The Invisible Gorilla

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Undergraduates are an important part of the equation for many laboratories at the Beckman Institute  
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Paul von Allmen launched a career at NASA's Jet Propulsion Laboratory beginning with a postdoctoral research associate position at the Beckman Institute.  
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Beckman Institute faculty member Pierre Moulin develops technology that makes it easier to stop movie piracy.  
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*A stint in the gorilla suit is a prerequisite for working in Dan Simons' lab, as student Natalie Henry finds out.*

## Simons Adds Title of Popular Author to his Resume

If a person is thinking about their own cognitive processes, they are practicing what psychologists call meta-cognition. If they are feeling confident about their own cognitive abilities, psychology researcher Dan Simons says there is a good chance they are wrong.

Simons reached that conclusion after doing years of experimental studies that demonstrated how flawed we humans are when it comes to accurately assessing our own cognitive abilities involving attention, visual perception, and memory.

It was the insight gained from his work that motivated this Professor of Psychology and Beckman Institute faculty member to take a stab at becoming a writer of popular non-fiction. And about a year ago, Simons' foray into the world of trade publishing paid off when he signed a book writing deal with Crown Publishing of New York.

Simons has co-authored the book on the topic of meta-cognition with his research collaborator at Union College, Chris Chabris. The book is scheduled for release in May 2010 and will use anecdotal evidence as well as scientific data as the two academics present their case to a general audience.

"We're trying to make it completely accessible," Simons said. "We have a lot of research in there, so we're trying to back up the anecdotes with the science. But it's going to rest on the anecdotes because that is what people find persuasive."

Simons said the use of anecdotes as a key element of the storytelling was a very deliberate decision by the authors. The book, titled *The Invisible Gorilla*, will be challenging some strongly-held notions involving topics that have been featured prominently in the media recently. The authors wanted to use the anecdotes – backed up by the science – to change people's thinking about some of

these topics.

"It's part of our nature; narratives are powerful," Simons said. "Unlike a lot of general audience books that make their arguments entirely using anecdotes and compelling narratives, we are trying to use narratives that lead directly to conclusions that are consistent with the science."

While he can't talk in detail yet about the book's contents, Simons is able to describe its principal theme.

"It's a look at meta-cognition and how we understand how our minds work and whether our intuitions are accurate or not," he said. "One way to think about it is that we lack access to a lot of the mechanisms that govern what we do a lot of the time, but we think we do have access to them. People will say 'oh I always notice mistakes in movies.' No, they don't. You notice the ones that you notice, but you don't know about all the ones you didn't notice. So we have this mistaken intuition that we notice everything."

Crown Publishing, which features bestselling writers like Alice Hoffman and Martha Stewart in its stable of authors, is a division of industry giant Random House. Simons said it wasn't an easy task to enter the world of big-time publishing. He said he first

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started working on a book proposal a couple of years ago when he was on sabbatical, but it took a while for them to get it polished enough to submit to publishers.

The process included a story pitch to publishers and writing some sample chapters. Simons said the pitch, ala Hollywood, involved describing the book as a cross between two non-fiction science-oriented best-sellers.

“The way we pitched it was a mixture of *Predictably Irrational* and *Blink*,” he said. “It was exactly the same as a movie pitch. In fact, they seem to work on a blockbuster model. They try and have a couple of big books for each season and a whole bunch of ones that they don’t pay very much for and hope that they will become unexpected hits.”

The book proposal also had to demonstrate that its topic could appeal to a wide audience.

“We wrote an introduction and we had an annotated table of contents for the rest of the book,” Simons said. “So we identified each of the chapters and wrote about a page describing the focus of each chapter. It had to be really catchy. This is popular writing. We are not targeting academics. Some people might use it in a class but it is not aimed at that.”

Simons said most popular science books are written by journalists, not scientists, and that those that are written by scientists often have a co-writer and/or have been heavily edited. That won’t be the case with his book.

“My co-author and I are pretty good writers but much better editors,” he said.

“That works really well in the sense that we can pass things back and forth 20 times and hone it until it’s pretty tight. We’ve got a good collaborative writing relationship and we’ve worked together for over a decade now.”

Their best-known collaboration was on the famous Gorillas in the Midst study, which won an Ig Nobel Prize in 2004 for science that makes people laugh and then think. That innovative study, which featured half of all test subjects not noticing as a person in a gorilla suit walked through a scene in a video, was part of their work at Harvard in the areas of change and inattention blindness.

Simons has continued that work at Illinois and Beckman, looking at topics such as automobile drivers not noticing motorcyclists and whether expertise in team sports leads to differences in basic attention abilities. The book will include research results from Simons, Chabris, and others, as well as a national representative survey the authors commissioned about beliefs and psychology. The motivation to write it, Simons said,



**Unlike a lot of general audience books that make their arguments entirely using anecdotes and compelling narratives, we are trying to use narratives that lead directly to conclusions that are consistent with the science.**  
— Dan Simons

comes directly from the research.

“It was the topic itself,” he said. “The more we thought about the phenomena that we looked at – this change blindness and inattention blindness – the more we found that people just don’t have the right intuitions. We started seeing more and more examples of it.

“I get e-mails from people I don’t know saying how they have encountered this in some context that I had never really thought about. The more I ran across that the more I realized that it was catching on as a popular notion. We just thought it would make for a good point to say that people just don’t get this in some fundamental way.”

What people don’t get, Simons said, is how much we overestimate the power and accuracy of our own cognitive abilities and feelings.

“People rely on their intuitions about how the mind works and their intuitions are often fundamentally wrong,” he said. “They are wrong for good reasons. Our system wasn’t designed to do the things we ask it to do now. Inattention blindness, the failure to notice something that is right there, doesn’t matter if you are just walking around the woods as a hunter-gatherer. If you are driving 60 miles an hour, it’s devastating.

“Our system evolved a property that is really good for us: focused attention. You don’t want to get distracted by every little thing or you would never get anything done. It is how our mind works. We think our memory is really good because everything we recall is vivid. It is counter-intuitive to us that our memory can be completely wrong but still feel right.”

False memories will be one topic discussed in the book, along with others such as inattention blindness, memory, confidence in cognitive abilities, untapped potential, beliefs in causality, and the controversy surrounding autism and vaccinations. Some of the topics they take on will be controversial, but Simons said those elements are crucial to making their points.

“One of our motivations is clichéd, but it is raising awareness,” he said. “The first step in having people do something is to get them to realize their intuitions are wrong.”

As an example, Simons said input from a friend when it comes to buying a new car can often be a more powerful influence than data sources and the opinions of experts.

“Say *Consumer Reports* says Toyotas are really reliable but your best friend tells you ‘I had a Toyota and it was a lemon, it was constantly in the shop.’ Even as a scientist it’s hard not to weight that far more heavily than you should,” Simons said. “You should completely discount it; the statistics are all that matters.

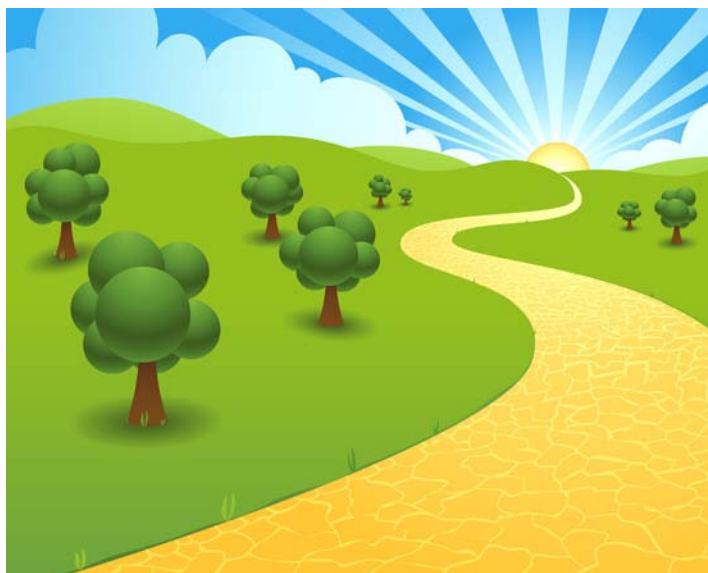
“But that anecdote is just so powerful. We’re all subject to it; I’m subject to it too. Would I be a little less likely to buy a Toyota? Yes, even though I shouldn’t be. That’s part of our goal, to give people an entry to more statistical thinking, more scientific thinking, that will help them counter those more immediate gut reactions.”

After all the editing of the book is done, then the process turns to legal vetting, artwork, and marketing. Although he has been interviewed by major media like the *Washington Post* and the *New York Times*, promoting a book will be a new experience for Simons. He hopes it will be a good one, just like writing a work of popular non-fiction has been.

“The style of writing is completely different than any kind of writing I have done,” Simons said. “I actually enjoy the style of writing; it allows you to go beyond your normal research domain, so that’s been fun.

“If the book does well, I could see doing more. If it doesn’t do well, I might not have the option,” he added with a laugh.





# DISCOVERING THEIR PATH

## BECKMAN RESEARCH EXPERIENCE BENEFITS UNDERGRADUATES AND LABS

William Greenough is a Beckman Institute founding father and research theme co-chair, as well as one of the most prominent neuroscience researchers in the country. But he started out his academic career as a journalism student.

During an interview with a psychology professor at the University of Oregon for a story, Greenough was introduced to the world of research. The professor was prominent neuroscience researcher Jim McGaugh, whose work Greenough had studied in preparation for the interview.

"When I went to see him I just wanted to see if there was a story there," Greenough said. "He really took the time to describe the experiment he was working on in great detail. He said 'now, what would you do for the next experiment?' I basically bluffed my way through it and he was impressed that somebody who just walked in could come up with these kinds of ideas. But I had read about every paper he had published."

Greenough ended up taking a class from McGaugh and getting into the fields of psychology and neuroscience research. Like Greenough, many undergraduate students working at Beckman have seen their academic and life plans change once they began doing research.

There are more than 300 undergraduate students who work on research projects or in labs at Beckman and many more who are

involved in research projects with Institute researchers. For many Beckman faculty members like Greenough, undergraduates are an important part of their research and laboratory work.

For some undergraduates, the experience of working in a lab or on a project has broadened the desire they already had to do research, while for others it has caused them to rethink where they were headed in life. In the case of University of Illinois undergraduate student Shelia Schneider, it was the latter.

Schneider agreed to take part as a subject in Beckman faculty member Deana McDonagh's Relevant Design and Disabilities class. Schneider, who is visually impaired, worked with a design student in the class, which includes students with disabilities as an integral part of the product design process. The class eventually led Schneider to working with McDonagh on more projects involving research and product development, as well as a new career path.

"It changed my whole direction," Schneider said. "My original direction once I got done with my sculpture degree was to create a space for people with disabilities to explore their creative sides. That was my original intent. When I got started with Deana, it just kind of rolled into something completely different, which I am really excited about."

For some students, doing research hasn't changed their goals, just added another dimension to academic and personal plans. Such was the case for Kim Lavin of Greenough's lab and Stuart Schelkopf of Beckman faculty member Jeff Moore's research group. Lavin chose biochemistry as a major specifically so she could do research, and joined Greenough's lab in order to work on projects that involve people.

"I wanted to do something I could relate to and he studies Alzheimer's and Fragile X," Lavin said. "I liked the idea of doing research that would keep motivating me."

Schelkopf said he was interested in organic chemistry and, while looking for a research group to do research, investigated the work that Moore's lab does.

"I didn't have a certain focus that I wanted to pursue so I went to him to see where he needed help and he placed me," Schelkopf said.

"Doing research really helps to get into grad school and it looks great on your resume, but I also really wanted to do research just because I love doing that."

Michael Kurowski said he didn't know anything about research before joining William O'Brien's Bioacoustics Research Laboratory at Beckman.

"I just heard bad things about research, like you don't want to be in a lab all the time; you want to be out making money," Kurowski said. "But being in the lab is so exciting because you're developing things. You are working in the field and your work is really pertinent. That's the best part about working in research, and that is something I didn't know until I got in the lab."

All four of the undergraduates are seniors at the University of Illinois. Kurowski will graduate in December with a degree in Electrical and Computer Engineering, while Schelkopf graduates in May with a degree in Chemistry and plans to go on to

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*Kim Lavin is shown in the William Greenough Laboratory.*



I would definitely encourage any freshman, sophomore, or student at any level to get involved with research.  
— *Stuart Schelkopf*

After her stint as a subject in McDonagh's class, Schneider took on a project for a competition that involved her and a collaborator designing a watch-like device that helps those with disabilities and others find their way around campus and within campus buildings.

McDonagh does not have a lab at Beckman, so Schneider's research experience is different than most Institute undergrads. She meets with McDonagh on a regular basis to talk about their current project involving tactile math. The project integrates Braille into sculptural forms that rely on gestural movements in order to teach mathematic principles to children with visual impairments. Schneider said that, as with any child, visually impaired children will have a better educational experience if they begin to learn early and before their condition worsens.

"What we're hoping to do is to generate interest in these grade school kids and give them a method by which they can learn mathematics instead of just relying on someone else," Schneider said.

For other undergrads, working in a Beckman researcher's laboratory has been one of the best experiences of their time at the University of Illinois. That is certainly true for Kurowski, Lavin and Schelkopf. They say the lab experience has added to their knowledge of how to do research, has made their scientific knowledge more broad-based, and that the research group experience has prepared them for other challenges, such as public presentations.

"You have to be prepared at all times," Schelkopf said of the Moore group meetings. "That is one of the most important things that I've learned. They're firing questions at you and they are always looking for new ideas. You really want to be an interactive member of the group so you want to bounce ideas off them. If you have a question they are always willing to help you out and throw some ideas out there to progress your research."

Kurowski said that O'Brien fosters a team approach in the Bioacoustics Research Laboratory.

"The thing about Dr. O'Brien is that is a large group and he does such an amazing job of keeping everybody together on the same

page," Kurowski said. "We are really close-knit. We have cookie time every Thursday where everyone meets informally and talks. We have summer get-togethers. Everyone is really close and it really helps the atmosphere in the lab."

Lavin will graduate in May with a Biochemistry degree and plans to go to medical school. Schneider is slated to graduate in May from the School of Art and Design with a degree in sculpture. Schneider is happy about earning her degree in sculpture but her future plans after college involve designing for people with disabilities, thanks to a conversion to McDonagh's approach to design, which includes the product user as an integral part of the designing process.

Lavin said she has gained specialized knowledge from working in the Greenough lab that she would not have gained elsewhere.

"I love my lab," Lavin said. "I have learned so much there. A lot of the processes and techniques you use in a psychology lab are very useful in many labs."

One experience the undergraduate students have appreciated is the attention they have received from their fellow lab members, whether it comes from postdocs, grad students or other undergrads.

Lavin said Greenough lab postdoctoral researcher Deepa Venkitaramani has been a tremendous asset for her.

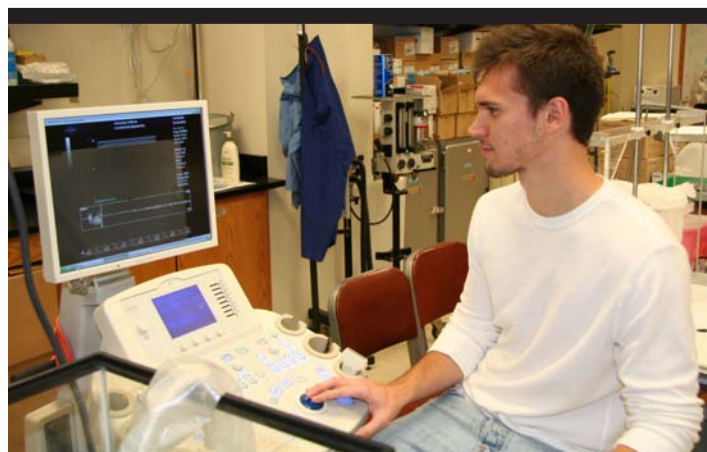
"Deepa has taught me so much more than what I had learned before," Lavin said. "She has so much experience that she can teach me all the little tricks that they would never teach you in a course."

Schelkopf said fellow Moore group members are "always willing to help you out and throw some ideas out there to progress your research."

"It's very challenging but it's really good preparation. It allowed me to improve my performance for when I presented at the Undergraduate Research Symposium for 2009 and also for the self-healing materials conference. It helps you do your research too because you have to know the ins and outs and know everything about the research you are conducting."

Kurowski said the BRL has a very open atmosphere.

"You can do as much work as you want and get involved in as many things as you want," Kurowski said. "If a student is working on a project, you go up and talk to them and they will explain everything



You are working in the field and your work is really pertinent. That's the best part about working in research, and that is something I didn't know until I got in the lab.

— *Michael Kurowski*

to you. It's remarkable."

Greenough has had many undergrads from his lab go on to success. One of his first students, Fred Volkmar, was recently named as one of four winners of the 2009 LAS Alumni Achievement Award from the College of Liberal Arts and Sciences.

Greenough has dedicated his career to doing research, but said that some undergrads find working in a research lab isn't for them.

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“People have a feel for a discipline or they don’t,” Greenough said. “People go into labs thinking they want to try it, but a good number of those say this isn’t for me. They say, I like my weekends before it is dark as well as after.”

But for those who do take to it, like Schelkopf, the experience is one worth recommending.

“I would definitely encourage any freshman, sophomore, or student at any level to get involved with research,” Schelkopf said. “It’s been a great experience and really helped me out. It’s allowed me to work with grad students who are brilliant in chemistry. If I have any questions I can go to them to help me with class as well as research. It’s very supportive.”

*Student Sheila Schneider (at left) meets with Beckman faculty member Deana McDonagh in the Beckman Café while Schneider’s guide dog, Heather, looks on.*



## Beckman Institute 20<sup>th</sup> Anniversary Wrap-up

### *Scientific Symposium Concludes Year-long Celebration*

At the end of the 20<sup>th</sup> Anniversary Celebration Year, as it was for the beginning of the Beckman Institute, there was the science. Built upon the concept of an interdisciplinary approach to research, the Institute’s scientific past, present, and future were showcased during the 20<sup>th</sup> Anniversary Symposium held in October that concluded a year-long celebration of Beckman’s two decades of existence.

The past year’s events included historical and personal accounts, scientific highlights, and reunions of the many people who created and nurtured the Institute over the years. An anniversary celebration commemorating Beckman’s official opening was held in April, while the 20<sup>th</sup> Anniversary events concluded October 5-7 with a scientific symposium that included attendees from California and China, nationally-known speakers, and most of the key players who were instrumental in forming and directing the research work that goes on here.

The Symposium opened with a keynote lecture from Nobel Laureate Susumu Tonegawa and concluded with “Visions for the Future” talks from three prominent Beckman researchers. In between, Symposium attendees learned about the scientific impetus for creating a center for interdisciplinary research at the University of Illinois, as well as research milestones at the Institute and current topics in its four research themes.

Among those returning for the Symposium were Pat Beckman, daughter of Arnold and Mabel Beckman, former associate director and research theme co-chair Karl Hess, and all three of the Institute’s three previous directors,

Ted Brown, Jiri Jonas, and Pierre Wiltzius. All of them gave talks during the Symposium’s second day, as did former Beckman faculty members and students.

Some of the key points delineating Beckman’s uniqueness as a research center during their talks were the fact that there is no tenure at the Institute, that the creation of three research themes in 1994 showed that research lines were maturing during its first decade, and that the creation of a new theme in 2009 demonstrates that the work is still evolving and dynamic.

Brown stated that the next generation of interdisciplinary research needs to be more aggressive and that the ideas that gave birth to the Beckman Institute are still valid but need to be updated. He said the research future also needs to include rapid follow-through from discovery to applications, and researchers who understand the social as well as scientific implications of their discoveries.

The first day also included a look at Beckman research milestones, as well as a tribute to Arnold Beckman and reflections from former students who experienced interdisciplinary research while working at the Institute before going on to careers in business, government, and academia. One of the former students, University of California-San Diego Psychology Professor Vic Ferreira, spoke on the second day and said that he “would never have had the career he has had were it not for Beckman.

“It seems to encourage people to think big thoughts,” Ferreira added.

The third and final day of the Symposium

featured a look at the research themes, with highlights provided by theme co-chairs and a researcher from each theme talking about their current work. The “Visions for the Future” talks that concluded the Symposium gave insight into where future research trends are headed.

Beckman faculty member Gene Robinson talked about a second genomic revolution as he said science has gone from the library to the Internet, and is now embarking on a second genomic revolution built on the first one involving the sequencing of genomes. Robinson said the second genomic revolution will be based on the ability to sequence a whole genome for less than \$1,000 and, in his research area, the future capability of sequencing bee genomes for \$99 or less.

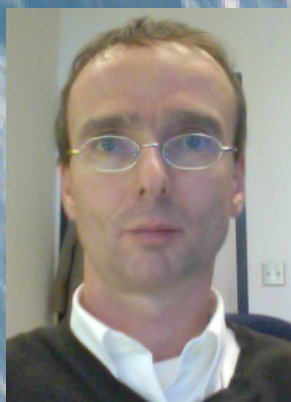
John Rogers of the 3-D Micro- and Nanosystems group envisioned future research involving skin-like electronics and stretchable silicon with rubber substrates for medical and other applications. Todd Coleman of the Artificial Intelligence group discussed future brain-machine interfaces for controlling computers with brain waves, and talked about building artificial intelligent systems such as affordable neuro-morphic supercomputers.

The Symposium had more than 200 attendees during its three days, with Xiaoping Li of the University of Singapore probably coming the farthest distance. Li said he was a visiting scientist who decided to extend his trip specifically in order to attend the symposium.

The Symposium ended with a call to have another celebration of Beckman Institute research – in 20 years.



## Beckman Alumnus von Allmen Looks Beyond Boundaries at JPL



It probably helps to have broad horizons when you work in the space exploration business. Paul von Allmen is a former Beckman Institute postdoctoral researcher who always has looked beyond boundaries.

A chance meeting with current Beckman researcher Jean-Pierre Leburton several years ago led to von Allmen leaving Europe to come to the University of Illinois and Beckman to work with one of the Institute's founding fathers, Karl Hess. Von Allmen leveraged his work here to land jobs in private industry, and then went on to head a computing research group at NASA's Jet Propulsion Laboratory ([www.jpl.nasa.gov](http://www.jpl.nasa.gov)) in California.

After earning a Ph.D. in physics from the Swiss Federal Institute of Technology in Lausanne, von Allmen went to work for IBM in Switzerland. It was there that he met

Leburton, who was visiting the company's facilities.

"I was looking for the next step," von Allmen said. "He asked if I wanted to come to Illinois. I asked around about what the University was like, got good feedback, and decided to give it a try.

"For me it was an opportunity to expand my knowledge base and also a chance to meet a number of really first-rate scientists and engineers. This was the main thing I took from my stay at the University."

After coming to Beckman in 1992, von Allmen collaborated with Hess on a number of projects and papers, including a seminal paper on developing first principals of an electronic structure calculation code.

"I had a fair amount of freedom with Karl in what was doing, which I really appreciated," von Allmen said. "It allowed me to go in directions I found interesting. He was a very good discussion partner for all the projects we were conducting. That was a good time for studying new subjects and expanding my knowledge base."

Von Allmen says the experience of working with Hess and others at Illinois is invaluable for his professional career.

"Developing first principals of an electronic structure calculation code was a big endeavor and it is knowledge that I am using now," he said. "Also, not too long ago I hired a quantum chemist and, without the knowledge that I gained through the work in Illinois, it would have been difficult for me to interact with this person."

Von Allmen is the supervisor of the High Capability Computing and Modeling Group at the Jet Propulsion Laboratory (JPL). Located at the California Institute of Technology in Pasadena, JPL is a NASA lab that develops tools for space exploration and spacecraft expeditions, but also focuses on projects involving studies of the Earth.

Von Allmen heads a research group that is involved in many of these efforts. As he has done throughout his career, von Allmen looked to broaden his group's mission and impact when he became its leader.

"When I came here a good portion of the group was really focused on nanotechnology and nanotechnology is not something that is high on the priority list at JPL or NASA," von Allmen said. "This means you can do this work if you get funding from outside agencies, which we did. But the people and

the group were not really perceived as crucial or important for JPL.

"It took me years to change that perception by integrating people into projects and sometimes into mission work that is highly visible and relevant to the lab. This is something I think I succeeded in doing. We have a reputation in the lab and even beyond as a group for doing important and useful work."

Von Allmen oversees a group of 26 people who spend most of their time doing research in computing areas that support a wide variety of projects. One current effort aids a European Space Agency comet intercept mission called Rosetta by providing data analysis and computational modeling of comets and their comas.

Other research projects include tasks that range from software development for accessing archives of NASA data or from agencies like NOAA to developing software packages for assessing data optically. Group members also write software for modeling physical properties of atmosphere of planets or moons, for modeling tsunamis, for astrodynamics, for spacecraft trajectory and mission design, as well as working in areas like image processing, radar data processing, and optimizing plans and schedules for space missions.

It is a highly diverse mission for a group, a fact that appeals to von Allmen. He says students who enjoy wide-ranging research can find as much fulfillment in industry or government labs as they do in university settings.

"Academia isn't the only place where you can work and do interesting research," von Allmen said. "Many people when they come out of a university, that is the only environment they know. They think the only place where they can do anything interesting is academia and that is just plain wrong."

Von Allmen advises students to stay broad in their research and learning paths.

"Keep an open mind to doing things beyond what you have been learning in school and keep acquiring new skills. I encourage that very strongly," von Allmen said. "I teach a class to the people in the group on some topic in mathematics that is really removed from what we do on a daily basis, but it keeps people learning and having an open mind."

*Background image credit:  
NASA/JPL/UCSD/JSC*



# Space Swap of Beckman Facilities Nears Completion

With one final push, the move of the Biomedical Imaging Center's instruments from their former location on south campus into the Beckman Institute basement was complete.

On Oct. 12<sup>th</sup>, the Biomedical Imaging Center's 3T Allegra Headscanner magnet was lifted and lowered, and pushed and pulled into the spot reserved for it ever since a swap of the Beckman service facility with its sister facility, the Illinois Simulator Laboratory, was begun more than a year ago. The swap included moving all of the equipment and personnel from BIC's building on south campus to Beckman, while simultaneously moving ISL's equipment and personnel from Beckman to what had been BIC's building. The two units shared office and instrument space in the former BIC building for several months.

The swap and renovation work at both facilities included a new acquisition for BIC with a Trio whole-body scanner installed in the basement in July. More acquisitions to Beckman's magnetic resonance imaging facility are expected in the near future. In



*The 3T Allegra Headscanner is moved by crane to the Beckman basement opening on the north side of the building.*

addition, remodeling was done in room 1215 at Beckman to add mock magnets for subject preparation and to create office space for BIC personnel.

The final piece of the swap will be completed with the move of the ISL's driving simulator into the south campus building.



## HONORS & AWARDS



### POP EARNS AFOSR YOUNG INVESTIGATORS AWARD

Eric Pop, a Beckman researcher and U. of I. Professor of Computer and Electrical Engineering, is one of 38 scientists and engineers who will receive a

2010 Young Investigators Research Program grant from the U.S. Air Force Office of Scientific Research.



### ROBINSON RECEIVES NIH PIONEER AWARD

Beckman Institute faculty member Gene Robinson has been awarded an NIH Pioneer Award. Robinson, a member of the NeuroTech group at Beck-

man, was the recipient of a \$2.5M award over five years from the National Institutes of Health.



### BOPPART WINS AWARD FOR UNDERGRADUATE RESEARCH EFFORT

Beckman Institute faculty member Stephen Boppert has been honored with the 2009 Paul F. Forman Engineering Excellence

Award for his contributions to undergraduate research. The award is given by the Optical Society of America.



### ROGERS NAMED 2009 MACARTHUR FELLOW

Beckman researcher John Rogers has been named a 2009 MacArthur Fellow by the John D. and Catherine T. MacArthur

Foundation. Rogers, the Lee J. Flory-Founder Chair in Engineering Innovation and a professor of materials science and engineering at the University of Illinois, is among 24 fellows who will each receive \$500,000 in "no strings attached" support over the next five years.



### ODOM EARNS NSF FELLOWSHIP

Susan Odom, a postdoctoral researcher with Beckman's Autonomous Materials Systems group, has been awarded a post-

doctoral fellowship from the National Science Foundation. The award, from the NSF's Division of Chemistry, is for \$200,000.



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# FACULTY PROFILE

**What makes me happy is research that is mathematically interesting and challenging. At the same time it should be useful. I spend a lot of time trying to select my topics because I want to choose ones that would be useful.**

**- Pierre Moulin**



As you watch a crime scene investigator in a movie look for evidence, know that the movie itself is providing a clue toward crime prevention. Most movies today include an on-screen yet invisible anti-piracy digital fingerprint that stamps the individual theater showing the motion picture – a fact which ties in to Beckman Institute faculty member Pierre Moulin’s research into the forensics of video and images.

Moulin, a Professor in the Department of Electrical and Computer Engineering and a full-time faculty member in Beckman’s Image Formation and Processing Group, is a leader in decoding those clues through his research into information hiding and extraction in images and video. He is the director of the Center for Information Forensics at the University of Illinois’ Information Trust Institute, where he studies issues such as digital fingerprinting.

“It actually is used a lot in movie theaters,” Moulin says of the technique of digital fingerprinting. “You can’t see it, you just see the movie and you don’t even know it has a fingerprint. It is projected on the screen, you just don’t see it.”

Moulin said modern movie piracy often involves recording with a high-quality camcorder in a movie theater that has been pre-arranged to include only the one doing the filming and the projectionist. A recent study estimates film piracy costs the industry more than \$6B a year, with more than 80 percent of the piracy taking place overseas.

Moulin describes a digital fingerprint as “an invisible pattern superimposed to the image (in case of image fingerprinting) or an inaudible pattern in the case of audio.” He said that once a pirated DVD is obtained, then the question becomes one of how to extract the digital fingerprint from it.

“These techniques are being used right now and in fact they catch people this way,” he said.

And that is where Moulin’s work comes in. He has developed applications for extracting digital fingerprints that are currently in use worldwide.

“My contribution in the field has been, what are the limits of what can be done, and what kind of fingerprinting technique can be developed which can approach those limits?” Moulin said.

Moulin, who earned an engineering degree in his native Belgium and a Ph.D. in electrical engineering from Washington University in St. Louis, came to the University of Illinois and Beckman in 1996 from private industry, where he worked for Bell Communications Research.

Moulin has a research focus on topics such as image and video processing, information hiding and authentication, statistical signal processing and modeling, and the application of multi-resolution signal analysis, optimization theory, and fast algorithms to the areas he is researching. He said mathematical theories undergird his work.

“My research in the field started with developing a mathematical theory for those problems. It’s a pretty big field so it took a number of years,” he said. “Based on the mathematical theory, then one can construct algorithms or methods which can be shown to be nearly optimal, where it’s almost impossible to improve them. There is only so much you can hide, with the requirements that it should be invisible and also detectable.”

Hiding information such as digital fingerprints in a movie and extracting that information when the need arises is the key focus of work at the Center for Information Forensics.

“It is a field that is quite multidisciplinary because it addresses issues that pertain to content of images and video and how you present them efficiently, and also to coding

techniques and information theory,” Moulin said. “There are several fields that are essential to doing this kind of work. The idea for a center like this is to put people with different expertise together so that it makes it easier to develop a solution.”

Moulin knows that research doesn’t always lead to solutions and commercial applications, especially in a field like image and video processing, but that goal is what drives his research.

“When I select a research topic, it should have an application,” he said. “That’s always a risk in this field. There are many techniques that were promising commercially and for some reason they were never applied. But that’s part of research – you never know what will be the commercial or economic impact.”

Doing research with an eye toward future applications has always been a credo of efforts at the Beckman institute.

“It’s a wonderful place with great colleagues and a great environment,” Moulin said of working at Beckman. “What makes me happy is research that is mathematically interesting and challenging. At the same time it should be useful. I spend a lot of time trying to select my topics because I want to choose ones that would be useful.”



# RECENT BECKMAN INSTITUTE RESEARCH IN THE NEWS



## LU PROJECT USES NATURE AS GUIDE FOR DESIGN OF PROTEINS

November 4 – A project led by Beckman Institute faculty member Yi Lu is using insights gained from natural processes to aid in the design of tailor-made proteins with numerous applications.

*U of I News Bureau*

## PHYSICAL ACTIVITY AND COGNITION

October 23 – Studies by Charles Hillman, a Beckman affiliate and U. of I. professor of kinesiology and community health, found physical activity can improve students' cognitive control – or ability to pay attention – and also result in stronger performance on academic achievement tests.

*KABC Los Angeles*

## HA FINDS PROTEIN IS DYNAMIC, CRITICAL TO DNA REPAIR

October 23 – Beckman Institute faculty member Taekjip Ha and his colleagues discovered that a single-stranded DNA-binding protein that was thought to be static is in fact dynamic, and plays a critical role in repairing DNA.

*U of I News Bureau*

## SMALL MECHANICAL FORCES HAVE BIG IMPACT ON EMBRYONIC STEM CELLS

October 19 – Researchers at the University of Illinois including Beckman affiliate Ning Wang report that applying a small mechanical force to embryonic stem cells could be a new way of coaxing them into a specific direction of differentiation. Applications for force-directed cell differentiation include therapeutic cloning and regenerative medicine.

*U of I News Bureau*

## NEWS-GAZETTE FEATURES BECKMAN INSTITUTE ON 20TH ANNIVERSARY

October 12 – The Beckman Institute's 20th Anniversary was the focus of a feature story in Sunday's News-Gazette. The article looked at the history and science of the Institute, mentioned Founding Director Ted Brown's recently published book about Beckman, *Bridging Divides*, and featured a photo spread. The online edition also included a pictorial retrospective of the Beckman Institute's 20 years.

*News-Gazette*

## VIRTUAL SYNTHETIC CHROMATOPHORE

October 1 – "Ninety-five percent of the energy that life on Earth requires is fueled by photosynthetic processes," says Klaus Schulten, a Beckman researcher and physics professor at

the U. of I.

*Scientific American*

## SEWAGE CONVERTER

September 21 – Mark Shannon, a Beckman researcher and professor of mechanical science and engineering at the U. of I., is raising funds to build a prototype anaerobic digester that will convert sewage into re-useable water, methane and a sludge of minerals that can be sold to manufacturers or brick makers.

*Greentech Media*

## BENEFITS OF EXERCISE

September 16 – In an experiment published in the journal of the American College of Sports Medicine, students at Illinois were noticeably quicker and more accurate on a retest after they ran, compared with the other two options, and they continued to perform better when tested after the cool down. "There seems to be something different about aerobic exercise," says Charles Hillman, a Beckman affiliate and an author of the study.

*New York Times*

## ARTIFICIAL NOSE FOR DETECTION OF TOXIC INDUSTRIAL CHEMICALS

September 14 – Beckman researcher and U. of I. chemistry professor Kenneth Suslick and his team at Illinois have developed an artificial nose for the general detection of toxic industrial chemicals that is simple, fast and inexpensive – and works by visualizing odors.

*AZom.com*

## CAPSULES FOR SELF-HEALING CIRCUITS

September 11 – Beckman researchers are developing a material that could let a circuit self-repair small but critical damage caused by, say, dropping a cell phone. "We want to address common failures in cell phones and other portable electronics," says Paul Braun, a professor of materials science and engineering at the U. of I. who leads the research project with Jeffrey Moore, a professor of chemistry, materials science and engineering.

*Technology Review*

## LYDING REVIEWS NEW METHOD FOR CREATING SUPERLATTICES IN CNTs

September 8 – Joe Lyding is the author of an article in *Nature Nanotechnology* reviewing the work of researchers who have developed a way to create an array of quantum dots, known as superlattices, in carbon nanotubes (CNTs). Lyding, leader of the Nanoelectronics and Nanomaterials research group at Beckman, writes that the method may help solve

one of the obstacles to using CNTs in future electronic devices.

*Nature Nanotechnology*

## FIRST AID FOR ELECTRONICS

September 3 – Jeffrey Moore, Beckman researcher and professor of chemistry at Illinois, and colleagues have developed a first aid kit for electrical systems that could stop circuits failing and lead to safer, longer lasting batteries.

*Highlights in Chemical Science*

## CORRELATING BRAIN REGION ACTIVITY WITH NATURAL SCENE CATEGORIZATION

August 27 – Beckman Institute researchers Diane Beck, Dirk Bernhardt-Walther, Eamon Caddigan, and collaborator Fei-Fei Li are reporting in the *Journal of Neuroscience* on their research looking at how the brain categorizes natural scenes. Using functional magnetic resonance imaging (fMRI) and distributed pattern analysis they were able to correlate activity in certain regions of the brain with natural scene categorization.

*Journal of Neuroscience*

## BRAIN-TRAINING GAMES GET MIXED SCORES

August 25 – Art Kramer, a Beckman researcher and professor of psychology at the U. of I. who specializes in brain changes and aging, says he personally doesn't use any brain training games, but makes sure to exercise five times a week. "I get enough mental stimulation in my job," he says. From Kramer's perspective, brain training games still haven't proven their value for the general public, either. "They may be fun, and that's good," he says. "But a lot of people have higher expectations."

*Los Angeles Times*

## NEW PROCESS FOR ULTRATHIN LEDs

August 20 – An article in the journal *Science* by Beckman Institute faculty member John Rogers and collaborators reports on their development of a process for creating ultrathin, inorganic LEDs for new classes of lighting and display systems.

*U of I News Bureau*

## SUSLICK DEVELOPS SWEET SENSOR

August 17 – In a new approach to an effective "electronic tongue" that mimics human taste, scientists at Illinois led by Beckman researcher and U. of I. chemistry professor Kenneth Suslick report the development of a small, inexpensive, lab-on-a-chip sensor that quickly and accurately identifies sweetness.

*Wired*