SYNERGY

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POSITIVE RESULTS:

Researchers are leading a revolution in biomedical diagnostics

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Beckman Institute researchers like Jeff Moore and Jennifer Cole also contribute to advancing science by serving as journal editors.

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Aron Barbey of the Cognitive Neuroscience group is off to an impressive start as a University of Illinois researcher.

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Mark Nelson is a leading software architect at Oracle who made an important contribution as a graduate student at Beckman.

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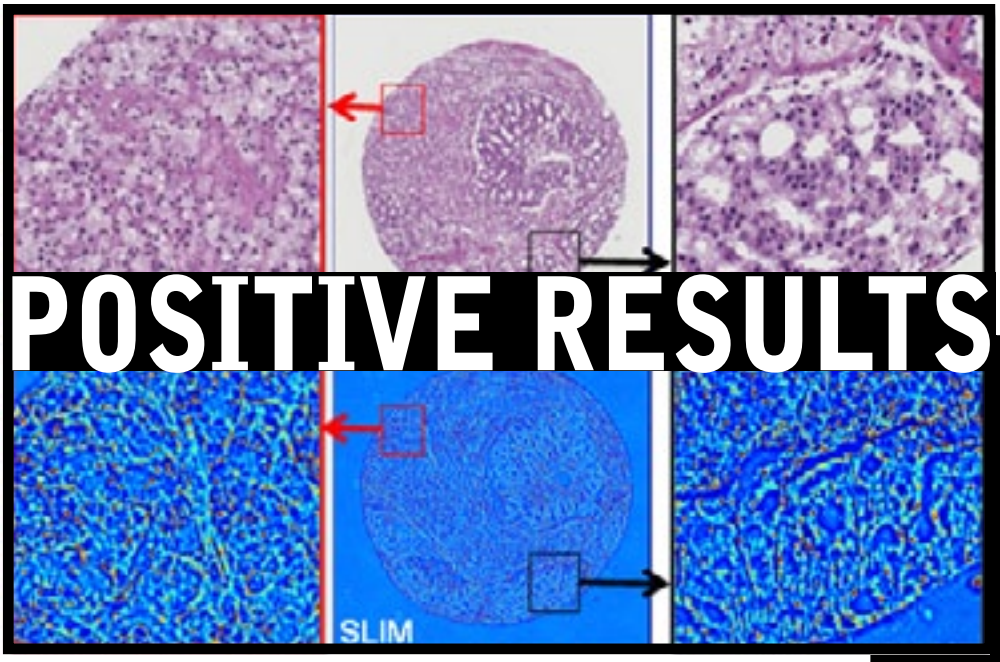

POSITIVE RESULTS

Image at left: Shown are biopsy slides of a 5+4 Gleason grade, or high grade tumor, done with the SLIM stain-free method, bottom, and standard histological staining at top. Images acquired by Shamira Sridharan.

Cover image: Fully inflated multifunctional balloon instrumented with temperature, tactile, and EKG sensors on islands interconnected by non-coplanar serpentine wires. Photo by Dae-Hyeong Kim.

New Era for Medical Diagnostics

A revolution in medical diagnostics and treatment has often been proclaimed because of recent advances like genetic screening and "lab-on-a-chip" technology. But this revolution, often referred to as personalized medicine, won't take place without a new generation of diagnostic devices that fundamentally change the way diseases are detected and treated.

And that technology is being developed, put into clinical trials, and in some cases commercialized by Beckman Institute researchers in work that could contribute to a truly different experience for patients in the near future.

Some of this technology includes electronic biosensor monitors that conform to skin or the heart, tissue assessment technology that eliminates the need for laboratory work, and handheld digital devices that can be used in the clinic or the operating room for a variety of purposes. Diseases will be detected much earlier at the cellular and even molecular scales, surgical procedures will be much more precise and less damaging, and patients won't have to wait days to hear whether a tumor is cancerous or benign.

One of the Beckman researchers working toward this new future in diagnostics is Stephen Boppart, Co-chair of the Integrative Imaging research theme. Boppart has already taken technology for non-invasive or minimally invasive breast cancer assessments and real-time surgical probes to the clinical trial stage. Boppart said revolution is not too strong a word to describe what is happening when it comes to technology advances in medical diagnostics and treatment.

"I think it's going to dramatically change things," Boppart said. "What we hope is that diagnosis is going to get shifted closer and closer to the point of care."

Those involved in this area of research at Beckman are taking a variety of paths toward that goal.

Taking Diagnosis Out of the Lab and Into the Operating Room and Doctor's Office

Boppart is using optical coherence tomography (OCT) as the imaging basis for technologies like handheld devices that produce immediate diagnostic images that are easy to read for medical personnel and time-saving for all involved. OCT uses a beam of near-infrared light and the tissue's light-scattering properties to provide high-resolution, micron-scale subsurface images.

Boppart and his collaborators developed an OCT-based system that proved successful in clinical trials for assessing tumor margins in breast tissue. These "optical biopsies" give immediate results and require no invasive, or perhaps only minimally invasive, procedures. Their viability as a diagnostic device has already been demonstrated in clinical trials at Carle Foundation Hospital in Urbana.

They are also developing an OCT-based handheld probe with multiple applications in the clinic and operating room. Beckman researcher Scott Carney collaborated on research that advanced the technology to provide a microscopy technique where computational image-formation renders high-resolution, three-dimensional images from blurry data.

The handheld optical imaging surgical probe — enabling what the developers are calling computed histology — will give physicians performing procedures on cancer patients the ability to image tissue *in situ*, meaning it provides information on a patient's tumor *during* surgery. The technology can also be used as a versatile diagnostic tool through integration with current instruments such as the otoscope and ophthalmoscope used, respectively, for ear and eye exams. Clinical trials using this device recently began at Carle Foundation Hospital and The Eye Center in Champaign.

Those methods, and others being developed by Beckman researchers, will play a role in reducing the reliance on time-consuming and expensive laboratory work, as well as the subjective judgments of medical personnel.

Boppart said diagnostic technology such as the ones he, as well as fellow researchers like Rohit Bhargava and Gabriel Popescu, are

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developing are based on biological changes that take place at the cellular and even molecular level, where disease first begins.

"We're developing techniques to get at molecular changes," Boppart said. "So much of medicine and pathology are based on structural changes. If we think of a pathologist looking at a slide, he or she looks at the cells and tissue structures. A radiologist will look at how organs and these anatomical structures are arranged.

"But with a lot of these techniques, we can get the molecular changes where disease starts. So a pathologist that has molecular information, not just structural, will perhaps catch disease earlier. The same is true for Rohit's work and Gabi's work."

A newly-developed handheld probe, shown at bottom left, will enable surgeons to image and assess tissue in a patient's tumor cavity during surgery. Photo courtesy Diagnostic Photonics Inc.

Stain-free Tissue Analysis

Bhargava has a research focus on integrating chemical information into imaging and other diagnostic applications, while Popescu combines different imaging modalities to both visualize and quantify the structure and dynamics of cells and tissues. Both are working on stain-free imaging techniques that would either complement or in some cases eliminate the need for laboratory work, especially the time-consuming, labor intensive method of staining that has undergirded tissue assessment for more than a century.

Popescu said the different approaches taken by Bhargava and himself are in fact working toward the same goal of assessing biological information without staining tissue for examination.

"They provide two facets of the same thing," Popescu said. "One is giving chemical information while we're looking at morphology information in great detail, more of the structural information."

Popescu used an imaging technique he developed called Spatial Light Interference Microscopy (SLIM) to create a method for stain-free assessments of tissue for cancer diagnosis. SLIM uses phase contrast microscopy and holography to combine multiple light waves that enable visualization of nanoscale structures, as well as providing quantitative information.

Using the method Popescu and his collaborators imaged more than 1,200 biopsies and were able to visualize unstained cells with high-resolution, high-contrast images and derive information about the molecular scale organization of tissue, revealing prostate tumors and breast calcifications. In addition, the technique is automated, and it provides quantitative data on structures at the cellular level.

Bhargava has a five-year grant from the National Institutes of Health to create a new diagnostic method for assessing prostate cancer, and is working on projects related to breast cancer detection and treatment. He uses infrared spectroscopic imaging to measure chemical changes, such as those associated with tumor-stromal cell interactions.

These label-free spectroscopic imaging methods elucidate biochemical events that correlate with aggressive disease through chemical changes in different parts of the tissue; they then use differential equations to predict the behavior of tumors. This type of method not only doesn't require tissue staining, but also is novel for combining important chemical information with structural information about cells.

Bhargava said that current methods provide, at best, a correct diagnosis about 50 percent of the time while an automated technology using chemical imaging techniques could provide more accurate diagnoses, for example, for prostate cancer and prevent unneeded surgery.

"The key question now is how do we determine who those people are who are going to get the truly risky kind of prostate cancer versus those who have incidental and age-related prostate cancer," Bhargava said. "It's a very powerful technique to look at both chemistry and structure simultaneously and our group pioneered this technology."

Biosensors for Patient Monitoring

John Rogers has gained worldwide attention going back more than a decade for his pioneering work with flexible and stretchable electronics. More recently, Rogers has applied the technology to biomedical purposes such as health monitoring.

In one project Rogers and his collaborators created an ultrathin flexible patch, or "electronic tattoo" as it was dubbed, for, among other applications, use as an epidermal monitor. The patches could be used to monitor brain or muscle activity – as is done with, respectively, EEG and EMG methods – but using a thin sheet of water-soluble plastic that, unlike those methods, is unobtrusive to the person wearing it.

Rogers led a project that also uses stretchable electronics for integration with standard endocardial balloon catheters. They first created an ultrathin sheet of electronic sensors that was successfully laminated to the heart in an animal model. Later they applied the technology to common endocardial balloon catheters, which are one of the least invasive methods used for angioplasty and other cardiac procedures.

Currently, cardiologists use rigid catheters sporting electrodes

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for applications like detecting arrhythmias. But the device created by Rogers and his collaborators can perform the same functions simultaneously, while softly pressing against heart tissue.

The stretchable electronics technology was created with the manufacturing methods of the semiconductor industry in mind, so it will easily fit into current manufacturing methods. Rogers' start-up company is already working to commercialize the technology.

Kenneth Watkin's research includes components that could impact diagnostics, such as developing contrast agents used in cancer diagnosis methods. Watkin is also working to create a battlefield helmet that uses biosensors embedded in the helmet pads to record data on trauma such as blast injuries to the head. Nanoscale computers power the biosensors for recording and analyzing real-time information on the extent of a head injury.

Rashid Bashir's research focus is on developing new technologies such as micro- and nanoscale structures that have biomedical applications. One project that is now to the commercialization stage involves a portable CD4 cell counting system for rapid detection of white blood cells. It's a small system that Bashir says could easily be used throughout the world, including in developing countries.

"It's coming out of our technology for global health applications for detection of HIV AIDS," Bashir said. "The idea is you put blood in a cartridge and in a matter of 10 minutes and for less than 10 dollars you can count the CD4 cells of white blood cells, the number of which corresponds to the level of HIV infection that someone has.

"This is an electrically-based method. It's a cartridge that is fully self-contained. All you need is a drop of blood. Essentially there is a handheld reader that is the size of a small toaster, so it's truly portable."

Turning Research into Diagnostic Devices

Bashir has a start-up company, Daktari Diagnostics, that creates diagnostic products specifically for what it terms "resource-poor markets." Its first product will be the Daktari CD4, which the company says is as easy to use as a glucose meter and "robust enough to be used anywhere, from a doctor's office to the most remote settings." Bashir said they expect the product to be on the market within a year.

Boppart also has a start-up, Diagnostic Photonics, Inc., which was created to advance medical imaging technology. Andrew Cittadine, CEO of Diagnostic Photonics, said they have received approval to start a small pilot study and enrolled their first patient in April for evaluation of the handheld probe. The next steps will include publishing results of the clinical trials, win regulatory approval, and then partner with a firm to develop the manufacturing infrastructure.

"We plan to be in large-scale clinical trials, for example a 400-plus patient study, in 2013 and 2014," Cittadine said. "I believe we could begin to see significant clinical use starting in 2015."

For most of these diagnostic devices being developed by Beckman researchers, the future is sooner rather than later.

"I think the technologies that are out there are wonderful and are proven and exciting," Boppart said. "They're proven from the physics point of view. They have to be proven now from the clinical point of view.

"I think we have done well at the technology point and have been successful, but there's going to be three or four other steps before this is going to be used. I think between five and ten years, we're going to see a lot of medicine changing in terms of how we practice it."

First CNLM Awards Illustrate Balanced Approach

The first grants awarded from the Center for Nutrition, Learning, and Memory demonstrate the balanced approach that the University of Illinois units and funding partner Abbott were aiming for with this first-ever interdisciplinary cognition and nutrition research center.

Thirteen proposals were selected to receive more than $12M in grant funding for interdisciplinary research projects investigating the links between nutrition, the brain, and cognition. The Center for Nutrition, Learning, and Memory (CNLM) was formed in late 2011 with a goal of fast-tracking research projects.

A "Grand Challenge" was announced in December as part of an annual competition for grant proposals focusing on "novel research that explores the development of nutritional compounds to enhance learning and memory at different stages within the lifespan involving cognition and nutrition."

CNLM is a partnership between Abbott Nutrition, a division of Abbott, and Illinois units, the Beckman Institute, the Institute for Genomic Biology (IGB), the Division of Nutritional Sciences, and the Neuroscience Program. Neal Cohen is the Illinois Director of the Center for Nutrition, Learning and Memory, while Keith Garleb, Director of Global Discovery Research at Abbott Nutrition, is the Abbott Director of CNLM.

This first round of grants will fund a wide range of research, led by more than 40 investigators representing 16 different departments and units on campus, and joined by postdoctoral fellows, graduate students and staff. Cohen was impressed by the quality of the proposals submitted and selected, and by the funding from Abbott for this initial round of its five-year commitment to the Center.

CENTER FOR
NUTRITION, LEARNING, AND MEMORY

"We are *very* pleased with the support we're getting from Abbott to move ahead aggressively, and also very pleased by the response we've gotten from the University of Illinois investigators," Cohen said. "They have really embraced these opportunities and come through with fantastic proposals."

In addition to a balanced approach to research, guiding principles of the Center include creating synergies between different kinds of efforts, and integrating Center-funded projects with current or proposed projects, such as those funded by National Institutes of Health grants.

The proposals selected represent a cross-section of departments and units at the University of Illinois, with collaborations stretching from the United States and Canada to Europe that include other universities, research centers, foundations, and Abbott Nutrition. Cohen said there will be more widespread collaborations, including international ones, in the second round, set to begin in July with proposal submission workshops for researchers.

"We're moving everything much earlier in the year for Round 2 than we had in Round One," Cohen said. "The new set of projects will begin in January. That means we are going to be soliciting proposals in the summer, early fall, with pre-proposals due on September 7th, which is less than five months from the start date of the Round One projects."

Beckman Researchers Contribute as Journal Editors

Beckman Institute researcher Jeff Moore sees parallels between his experience working on the family dairy farm and his service as an editor for the preeminent peer-reviewed journal in the field of chemistry.

"I have told people this many times: I grew up on a farm and my parents raised dairy cows," Moore said. "Being a journal editor is an awful lot like being a dairy farmer. The milk is produced 24-7, 365 days a year and, honestly, articles come in 24-7, 365. I put that as a high priority throughout the year, including the times when I'm technically on vacation. I don't hand it off. It's basically part of my daily life, every single day."

The process of publishing your research results in a peer-reviewed journal is a fact of academic life every Beckman faculty member knows well. Publishing in a scientific journal not only plays an important role in furthering science, but also in furthering careers.

Journal editors like Moore and Jennifer Cole of the Cognitive Science group say the drive to publish has only grown in the past 20 years; combine that with the Web-based submission, review, and publishing process that is now the norm, and the result is a changing landscape for journal editors and reviewers, as well as authors.

Submitting papers and research images via the Internet has been used in journal publishing for more than 15 years, while the use of web portals to streamline the whole process of submission to publication is becoming more and more common.

"You just can't even imagine doing things by paper anymore," said Cole, who is General Editor of *Laboratory Phonology* and a leading linguistics researcher. "The push is toward completely automating the whole submission to publication process so it's all done web-based. The portals are newer but they are becoming the industry standard."

The ease of submitting over the Internet comes at the same time that there is a greater drive for researchers of all disciplines to publish.

"The publication culture in linguistics has changed radically in 20 years," Cole added. "There is definitely a pressure on people to publish a certain number of papers in a certain type of venue. A productive scholar would produce maybe one major work every year or two years and some major scholars would produce a major work every five years. If it was a major work, that was judged to be significant and adequate, but that doesn't' really pass muster anymore."

Changing Landscape for Editors

This drive is played out in newer, online-only journals and century-old publications with an online presence that delivers news of big breakthroughs weeks before it appears in print.

The Beckman Institute used to have a library featuring the latest journals from different disciplines, but it was shuttered almost 10 years ago. Stephen Boppart, Co-chair of the Integrative Imaging research theme, has been a book editor, guest editor for journals, and reviewer, and embraces the changes in publishing – with a caveat.

"I joke that the only time I set foot in the library is with my kids, these days," Boppart said. "I think online is convenient, but I think maybe we lost some of those historical references. And the other thing, which I fear, is that, as we have this proliferation of journals and articles and papers, the quality gets watered down. It has driven me to know better which the quality journals are and only to focus on those."

Moore, a member of Beckman's Autonomous Materials Systems group, is Associate Editor of the Journal of the American Chemical Society (JACS for short). He has a JACS editorial assistant with an office near his own on the third floor of the Institute. He is just one of many Beckman researchers who have served, or are currently serving, as editors, reviewers, or guest editors for journals or book chapters in their discipline.

Moore knows both sides of the publishing process, as research paper writer and as reviewer and editor. He does receive compensation for his efforts but that is not his driving motivation.

"I invest a significant chunk of time in this," Moore said. "I do it, obviously, because I enjoy the science. I also enjoy the opportunity to help because it is something I feel very sincerely about."

Cole, who is not paid for her current work as a general editor but did receive compensation for previous service on an editorial board, said serving as an editor allows her to play a larger role in her discipline.

"As a general editor you can actually try to stimulate people to submit in areas that you feel have some promise," she said.

And, she said, it also enhances her work, for both research purposes and for mentoring students. Those are the same reasons why Cole recently agreed to take on another task, serving on the editorial board for a new online version of an important reference volume in her field.

"I really thought long and hard about accepting it but I agreed because that kind of material is so valuable to me, and particularly my graduate students," she said. "I'm trying to encourage them to broaden their knowledge

and to not make assumptions about what people are saying on a question they are not familiar with. This kind of online material makes it so convenient, and to have it as an online publication is really important because it means it will be updated more frequently."

The Value of Journals

The changeover to online that has been taking place for more than 15 years has also moved academic publishing into the modern digital media realm where free access to information has become an expectation. Open access to federally-funded research has been a hot topic of debate recently, especially after a recent bill proposed in Congress called for restrictions on access to such research.

Funding agencies sometimes have a mandate that requires publishing results within a certain time period. On the other hand, research papers often require an expensive journal subscription to access, even though some organizations like the University of Illinois cover the costs of those subscriptions for faculty and staff.

A recent bill called the Research Works Act proposed restricting public sharing of federally-funded research unless the publisher agreed to open access. Some publishers, including many for-profit organizations, supported the bill, while other groups such as academic presses and the American Association for the Advancement of Science (publisher of *Science*), did not.

The bill was ultimately withdrawn but the debate continues. Some think all taxpayer-funded research should be open to the public.

Moore has been an editor as well as journal contributor for many years (joining with Nancy Sottos and Scott White on a seminal paper on self-healing materials in *Nature* in 2001), so he has insight into the different perspectives on access.

"I understand why the world these days has gotten used to getting everything for free," Moore said. "But when you understand the behind-the-scenes work, you realize there isn't a business model that really allows that information to be distributed freely and to remain at its current high quality.

"From my standpoint, as a researcher and as an editor, what I value the most is being able to go on the American Chemical website, have a very robust, reliable platform where information is easily found and then easily accessed and trust that it has, a) been through a rigorous review and, b) will be available for many years to come. The importance of being able to access that information is worth the money that universities and others pay for those subscriptions."

Moore said he thinks the current business model for journals works well in maintaining high scientific review standards and a quality product.

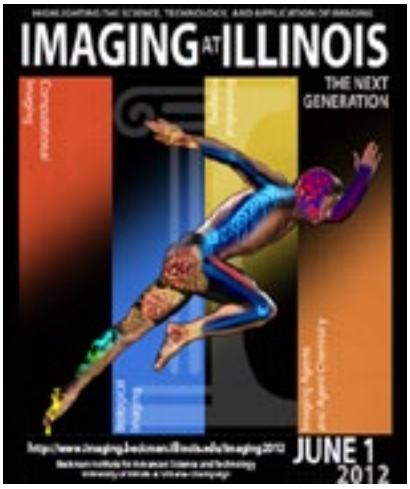
"Many of the high quality publication organizations are non-profit organizations; there are of course profit organizations too, but if you look at the American Chemical Society, for example, or the Royal Chemical Society, they are non-profit," he said. "But to do a quality job, in terms of delivering publications that are both rigorously peer-reviewed and presented to the world in a way that is meaningful and understandable, there needs to be a huge infrastructure that backs all of that up.

"The peer review system has its faults, but it works pretty darn well."

Those peer-reviewed publications also need reviewers. Cole said reviewing is an unpaid but expected aspect of academic life and while she is not paid, believes it benefits researchers to serve as editors and reviewers.

"I think it's really worthwhile because of the enrichment you get for your own scholarship," she said. "It makes you a better writer because you read a lot of other people's work and you have a sense of what an effective writing strategy is and also what ineffective writing strategies are.

"You can incorporate that into your own work, it makes you better. It helps to mentor students. You can see a big range of work that gets submitted for journal publication and I can try to advise my students to adopt effective practices."



REGISTRATION OPEN
Imaging at Illinois: The Next Generation

Imaging at Illinois: The Next Generation conference is set for June 1, 2012. This conference will highlight biological, biomedical, computational, and chemical imaging. This year the conference will be specifically focused on encouraging research innovation and education in younger researchers. Registration is open now through May 25, 2012.

www.imaging.beckman.illinois.edu/imaging2012/

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FACULTY PROFILE: Aron Barbey

Aron Barbey earned a Ph.D. in Psychology from Emory in 2007 and joined the University of Illinois and the Beckman Institute in the fall of 2011. In between, he made the most of his time as a postdoctoral research fellow with the National Institutes of Health (NIH) by creating a research program that not only has given new insights into the functional organization of the prefrontal cortex, but also may eventually aid people suffering from neurological disorders and traumatic brain injury.

Barbey, a member of Beckman's Cognitive Neuroscience group, is an Assistant Professor in the departments of Speech and Hearing Science and Psychology, as well as the Neuroscience Program. In his first academic year at the University, Barbey has published several papers, including one that mapped the neural architecture of human intelligence in one of the largest and most comprehensive analyses ever done.

"The study investigated a remarkable sample of 182 patients with focal brain injuries and identified a distinct neural system that is responsible for key competencies of general intelligence," Barbey said. "The findings suggest that intelligence relies not on one brain region or even the brain as a whole, but involves specific brain structures working together in a coordinated fashion."

Barbey directs the Decision Neuroscience Lab and is affiliated with the Center on Health, Aging, and Disability, and the NeuroEngineering IGERT Program. He has a research focus on the neural mechanisms of human thought, reasoning, and decision making, and their disturbance in psychiatric illness and traumatic brain injury. He said his research is focused around three main areas.

"The primary goal of our research is to understand the neural architecture of executive processes in healthy volunteers," Barbey said. "We also seek to understand how these mechanisms are shaped by experience and altered through psychiatric illness and neurological disease.

"Finally, we attempt to translate these findings into clinical practice by investigating the beneficial effects of cognitive, fitness, and nutritional interventions on executive function and brain health."

Barbey said he uses a number of neuroscience methods in his research, including structural and functional brain imaging and the experimental behavioral study of patients with brain injuries.

> "The findings suggest that intelligence relies not on one brain region or even the brain as a whole, but involves specific brain structures working together in a coordinated fashion."
> — Aron Barbey

The paper on mapping of human intelligence received worldwide attention, but Barbey said it is just one example of how he is using neuroscience evidence to investigate the mechanisms that shape higher cognitive functions. Barbey also led a collaborative team that received a grant in the first round of funding from the newly-created Center for Nutrition, Learning, and Memory for a study on nutritional intake, cognitive function, and measures of brain aging.

"This project is a great example of the integrative, multidisciplinary, and highly collaborative approach to research at the Beckman Institute," Barbey said. "Our project is a large-scale effort that includes collaborations between scientists here at the Beckman Institute and at Carle Foundation Hospital, where we will work with a team of physicians in the Carle Research Institute and Department of Neurology."

Barbey said he is using the facilities at Beckman's Biomedical Imaging Center on studies of several groups, including a study investigating the functional organization of the human prefrontal cortex in healthy volunteers, and a study involving veterans from the wars in Iraq and Afghanistan with traumatic brain injury and psychiatric illness.

Barbey said using neuroscience to detect disease at a very early stage is something he is excited about.

"Can we identify neural, genetic, and nutritional biomarkers in individuals with a specific disease before their symptoms ever emerge and can we intervene so that the individual never has the worst version of that disorder at all?" he said. "We are hoping that neuroscience will allow us to identify biomarkers that can further inform the course of treatment, identifying which individuals will really benefit from which forms of therapy.

"How much we are learning about the neural, genetic, and nutritional foundations of the human mind is so fantastic that it's hard to believe that we won't make great insights in the coming years."

Beckman Alumni Profile:

Mark Nelson

Degree: Masters of Computer Science, 1995
Then: Theoretical and Computational Biophysics Group
Now: Software Architect, Oracle

University of Illinois alumnus Mark Nelson doesn't work with biologists or physicists in his job at information technology giant Oracle. But his involvement with those scientists and their fields at the Beckman Institute helped pave the way for his current position as a software architect.

Nelson was an original author of the code for the hugely successful NAMD molecular dynamics simulation software developed at Beckman's Theoretical and Computational Biophysics (TCB) group. The TCB program has been used by more than 30,000 scientists from around the world to simulate atomic scale processes such as mutations in viral proteins.

Nelson was a graduate student in computer science at Illinois in 1993 when he joined TCB to help write a new software program to replace one that had code consisting of two-letter abbreviations in German.

"Not speaking German, it pretty much made the code completely unreadable to me," Nelson said. "So we decided we needed to have another program that was written from the ground up to be a platform for us to try what we wanted to try, and hence, NAMD was born."

Today, NAMD's ability to simulate molecules doing the kinds of intricate dances involved in biological processes is providing unprecedented, atomic-scale insight for scientists in a variety of fields. Even though he says his old code is probably gone by the wayside, Nelson says the experience taught him a lot.

"The lessons I learned at Illinois and being in the Theoretical and Computational Biophysics group were certainly the ability to dive in and learn an applied problem and build a platform where that problem can be solved," Nelson said. "For me, the interesting thing about computer science is not necessarily computer science itself; it's the fact that you can apply it to just about any problem in the world.

"This was kind of my first large scale 'diving in' and using computer science to solve a problem. It happened to be theoretical biophysics, but the basic process is still the same. You spend six months learning what the problem was, and then developing software to solve it."

And that problem-solving aspect is what still drives Nelson today as a senior software architect for a number of different products, including Oracle Public Cloud.

"That's the interesting part of computer science to me," Nelson said. "I have gone on to use that same basic principle of learning what people want and need their software to do and designing software to meet those needs. That is my job. It's on a different scale and a different problem space, but it's still the fundamental problem."

At Oracle, Nelson sets the technical direction for several groups writing software for different projects, using the analogy of a building architect to describe his role.

"I help build the blueprints for the software that is being built here at Oracle for a number of products, most notably Oracle Public Cloud and Fusion Middleware," he said.

Their target customers are in the business world but the goal is the same as when he worked at Beckman: providing a tool that meets the user's needs. Nelson said he and his collaborators on the NAMD code did that by working with TCB Director Klaus Schulten and others and by making the code adaptable.

"For the physicist, the number one rule was to be able to do real research with it," Nelson said. "Klaus and his students at the end of the day needed to do research and get real results. The way to get better results was to be able to quickly incorporate new ideas from the computer science professors and from Klaus on the physics side of things, because they were also trying out new techniques and new algorithms.

"So the key to success was to be able to plug in the new algorithms without every time saying, 'oh, I have to start a new program and write a new program every time.' I think NAMD is still around because it's become this platform that has good features where people are able to innovate on top of it very quickly. And I think that idea, whether any of my code lives on or not, that purpose of NAMD specifically as a platform to try these things out, that's clearly why it has been successful. It has become this bed of innovation for both the physicists and the computer science investigators."

That type of collaboration across disciplines is what Beckman is known for, and something Nelson appreciated during his time here in the early 1990s.

"What I learned, certainly, from TCB and being in Beckman in general, was that the strength of Beckman was this mish mash of different disciplines in one place," he said. "I thought that was awesome. I had a great experience learning biophysics and half of my time was not really doing computer science; it was learning biophysics so I could apply my computer science problem to it.

"Whereas if I had been purely in the computer science department doing something purely computer science related, I might not have had that chance. I think that it's great and NAMD proves that there are great things that can come from this type of collaboration, where the departments really mix together."

Changing Landscape: New ECE Building Taking Shape

In just a few weeks the area just south and on the west side of the Beckman Institute has been transformed. What was a grassy square marked by an x where two footpaths crossed is now a huge hole filled with bulldozers, cranes stretching more than 100 feet into the air, and yellow hardhats worn by construction workers rapidly creating a foundation for the new Electrical and Computer Engineering building. Scheduled to be completed in 2014, the building will house offices, labs, and — new for our northernmost area of campus — classrooms. The construction has led to some rerouting for pedestrians, loss of racks for bicyclists, and the effects felt inside Beckman when steel beams are pounded into the ground of the new building's footprint. But when it's all done, Beckman will welcome a new neighbor. Check out a representation of how the building will look and a webcam at the ECE website http://www.ece.illinois.edu/ and some of the work so far in the pictures below.

HONORS & AWARDS

Liang Elected to Academy of Medical and Biological Engineering

Liang

Zhi-Pei Liang has been elected to the International Academy of Medical and Biological Engineering (IAMBE). Liang, who is Co-chair of the Integrative Imaging research theme, was honored by IAMBE for his "distinguished contributions to the field of medical and biological engineering." The official induction ceremony will be held May 27, in conjunction with the World Congress on Physical and Engineering Sciences in Medicine.

Zhong Chosen to Receive Sloan Fellowship

Zhong

Sheng Zhong has been chosen to receive a 2012 Sloan Research Fellowship from the Alfred P. Sloan Foundation. Zhong, a member of the Bioimaging Science and Technology group, was one of 126 early career scientists and researchers from 51 colleges and universities chosen for the two-year fellowship.

Innovation Awards Honor Beckman Researchers

Lu

Several Beckman Institute researchers were nominated for awards at the seventh annual Innovation Celebration, with Yi Lu winning the Innovation Discovery Award given by the University of Illinois. Scott Carney, Stephen Boppart and Gabriel Popescu were also nominated for awards at the event held at the Beckman Institute.

Lewis Named to AAAS

Lewis

Jennifer Lewis is one of two University of Illinois faculty members named to the American Academy of Arts and Sciences. Lewis was honored for her contributions to her field of Materials Science and Engineering.

Two Beckman Research Projects Make 'Science News of the Year'

Two projects from Beckman Institute researchers made the list of "Science News of the Year" in technology for 2011. The work of John Rogers involving epidermal electronics and self-healing battery technology being developed by Jeff Moore, Nancy Sottos, and Scott White were chosen.

Simons Named APS Fellow

Simons

Dan Simons, a member of the Human Perception and Performance group, was awarded Fellow status with the Association for Psychological Science (APS). Simons was recognized for making sustained, outstanding contributions to the science of psychology in the areas of research, teaching, and/or application.

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RECENT BECKMAN INSTITUTE RESEARCH IN THE NEWS

What Cocktail Parties Teach Us

April 24 – Diane Beck and Daniel Simons talk about inattentional blindness and the problem with multitasking in a story about various research projects involving the brain and attention.

Wall Street Journal

Beckman Team Develops Method for High Quality 3-D Tissue Images

April 23 – Beckman Institute faculty members Scott Carney and Stephen Boppart and postdoctoral researcher Steven Adie led a team that created a computational method which turns flawed optical tomography images into high quality, three-dimensional images for applications in medical diagnostics.

U of I News Bureau

Controlling Heat Flow with Atomic-level Precision

April 23 – Paul Braun of the 3D Micro- and Nanosystems group was part of a team of materials scientists which showed that a single layer of atoms can either enhance or disrupt heat flow across an interface between two materials. Improving that heat flow is important for improving the performance of new and emerging technologies.

U of I News Bureau

How Exercise Could Lead to a Better Brain

April 18 – The work of both Beckman Institute Director Art Kramer and researcher Justin Rhodes is the basis for a feature article on how exercise can lead to improved cognition.

New York Times

Work on Exercise, Addiction, and Treatment is Featured

April 11 – A study by Beckman Institute researcher Justin Rhodes and graduate student Martina Mustroph showing the important role that exercise can play in addiction and treatment is featured in a New York Times Health section article.

New York Times

Barbey Does Comprehensive Brain Mapping of Intelligence

April 10 – Beckman Institute researcher Aron Barbey mapped brain regions that are critical for both general and specific aspects of human intelligence in one of the most comprehensive analyses ever done of those areas.

U of I News Bureau

New Insight Into How People Recall Personal Memories

April 10 – Florin Dolcos of the Beckman Institute's Cognitive Neuroscience group led a study showing that a person's personality, gender, and how they regulate emotions play important roles in recall of autobiographical memories.

U of I News Bureau

Dolcos Comments on Study Looking at Brain Activity During Stressful Situations

April 4 – Beckman Institute researcher Florin Dolcos talked about a new study showing that activity in certain parts of the brain can be used to predict how well someone will perform in a pressure situation.

Science News

Rogers Talks at ACS Meeting about Biocompatible Electronics

March 27 – Beckman Institute researchers John Rogers gave a presentation about his work involving biocompatible electronics for applications like skin patches that can be used as monitors at the Spring 2012 National Meeting and Exposition of the American Chemical Society.

ACS

Pioneering Work on Self-Healing Plastics Featured

March 27 – A story on self-healing plastics includes the seminal work done by Beckman Institute researchers Jeff Moore, Scott White, and Nancy Sottos of the Autonomous Materials Systems group.

MSNBC

Schulten's Group Among First to Use New Blue Waters Supercomputer

March 22 – Beckman Institute researcher Klaus Schulten was among the first scientists to use the new Blue Waters sustained-petascale supercomputer at the National Center for Supercomputing Applications. Schulten, who leads the Theoretical and Computational Biophysics group at Beckman, and his team created the first-ever all-atom dynamic simulation of an HIV virus capsid in its tubular form.

NCSA

Forbes Reports on iCub

March 19 – The iCub, an advanced humanoid robot created by a European Commission consortium to study human behavior, is the subject of a feature in *Forbes* magazine. The Beckman Institute's Language Acquisition and Robotics laboratory headed by Stephen Levinson, was awarded an iCub in 2009 and is home to the only one in the Western Hemisphere.

Forbes

Lifestyle Changes Help in Fight Against Dementia

March 14 – An article on research showing that lifestyle changes can delay, stop, or even reverse dementia includes the work of Beckman Institute Director Art Kramer. "I think the news is good that there are steps we can take before that wonder drug is discovered to enhance the health of the brain," Kramer is quoted as saying.

CNN

Ha Comments on Development of New Sensor

March 12 – Beckman Institute faculty member Taekjip Ha comments on the development of a sensor based on RNA for fluorescent imaging of molecules and proteins in living cells.

Chemical and Engineering News

Simons Comments on Comprehensive Exams

March 5 – Daniel Simons of the Human Perception and Performance group comments on comprehensive exams: "We don't want students to stop and just read. They should read as they research."

The Chronicle of Higher Education

Device Developed for Sniffing Out Cancer

March 2 – Technology developed by Beckman Institute researcher Kenneth Suslick is at the heart of a machine that analyzes vapors for potential application as a cancer-sniffing device.

Bloomberg Businessweek

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RECENT BECKMAN INSTITUTE RESEARCH IN THE NEWS

Huang Part of Team Studying Chess Player Brains

February 22 – Chih-Mao Huang, a graduate student in the Cognitive Neuroscience group, contributed to a project that studied the way chess players' brains work in order to better understand how visual information is processed.

Medical Express

Kramer Talks to AAAS About Exercise Research

February 20 – Beckman Institute Director Art Kramer spoke to the annual meeting of the American Association for the Advancement of Science last week about his research showing the cognitive benefits of exercise. A story on the research highlights Kramer's talk.

The Telegraph

Research Cited in Deforestation Myths

February 16 – The work of Ashwini Chhatre showing that community-owned forests are more efficient at storing carbon dioxide than those owned by the government helps debunk some myths about world deforestation says one writer. Chhatre is a member of the Social Dimensions of Environmental Policy Strategic Initiative based at the Beckman Institute.

Yale Environment 360

New Quantitative Microscopy Method Offers Stain-free Cancer Detection

February 9 – The century old process of staining biological tissue for examination under a microscope is today still the standard assessment tool for pathologists looking for signs of cancer. Now a new quantitative method for cancer diagnosis that does not require tissue staining has been developed through a collaboration led by Beckman Institute researcher Gabriel Popescu.

Medgadget

Study Provides Insight into Competitive Social Interactions

February 6 – Beckman Institute Fellow Kyle Mathewson and former Beckman faculty member Ming Hsu report on their research that showed how the human brain assesses behavior and likely future actions during competitive social interactions. The researchers used functional Magnetic Resonance Imaging and, for the first time in this type of research, a computational model in their study in which participants played a competitive game called Patent Race.

U of I News Bureau

World's Most Efficient Solar Panel Created

February 6 – A company that uses solar cell technology developed by John Rogers says it has created the world's most efficient solar panel.

Rogers is a member of the Beckman Institute's 3D Micro- and Nanosystems group.

Technology Review

Technology for Solar Cells Developed by Rogers Ready for Production

January 30 – A company that began with the work of Beckman Institute researcher John Rogers is now on the verge of producing solar cell technology.

Herald Sun

NSF Magazine Spotlights Flexible Electronics Research

January 30 – The work of John Rogers involving elastic electronics is featured in a story and video for the National Science Foundation's online magazine. The video features Rogers talking about the potential benefits of the bio-compatible, flexible technology in biomedical applications such as heart and brain monitoring.

Science Nation

Bloomberg Features Profile of White

January 27 – Beckman researcher Scott White is profiled for his work with self-healing materials and for his entrepreneurship. White is a member of the Autonomous Materials Systems group.

Wall Street Journal

Using Basketball for Improving Fitness & Mental Performance

January 26 – The research of graduate student Laura Chaddock is mentioned in a story on using sports to improve mental performance.

Salt Lake Tribune

Rogers Comments on Tiny Nanotube Transistor

January 26 – John Rogers of the 3D Micro- and Nanosystems group comments on the development of a nanotube transistor of less than 10 nanometers.

Technology Review