

FLC NORTHEAST REGION NEWSLETTER – FALL 2008

2008 Northeast Regional Award Winners Honored

The Northeast Region recently presented its annual awards honoring outstanding technology transfer achievements. The award winners were recognized at a ceremony during a Northeast regional meeting at Brookhaven National Laboratory in Upton, New York. This year's winners include the following.

Rowan University

Industry/Non-federal Government/University Award

Rowan University, located in Glassboro, New Jersey, received the award for its outstanding efforts to promote the actual transfer of federal technology transfer in the Northeast Region. The university entered into a Cooperative Research and Development Agreement (CRADA) with the Federal Aviation Administration (FAA) to develop and improve graphical user interfaces (GUI) for the display of predicted and recorded air traffic data, as well as a visualization framework. The FAA/Rowan partnership was established with the primary goal of increasing Rowan students' exposure to real-world projects in software engineering and other upper-level computer sciences courses, while allowing the FAA to receive quality professional software products and research expertise.

The partnership enabled Rowan to establish the FAA/Rowan Air Transportation Research Laboratory, where the GUI software was perfected. Since the CRADA's inception, 17 undergraduate students have participated on projects in the Laboratory. The students have been honored by the Director of the FAA William J. Hughes Technical Center, located at Atlantic City International Airport, New Jersey, and have presented their work at the Rowan Science, Technology, Education and Mathematics Student Research Symposium. In addition, the experience the students gained through their participation in the partnership has helped many of them secure jobs in the aviation industry.

Lewis Meixler, Princeton Plasma Physics Laboratory

Regional Coordinator's Excellence Award

Lewis Meixler of the New Jersey-based Princeton Plasma Physics Laboratory (PPPL) received the Regional Coordinator's Excellence Award in recognition of his significant contributions to the FLC program. Since 1991, Meixler has been the Head of Technology Transfer and Applications Research/ORTA at PPPL. In addition, Meixler has been an active member of the Northeast Region and has served as Deputy Regional Coordinator since 2005.

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NE Regional Awards (cont.)

Meixler has contributed greatly to the Northeast Region's outreach and technology transfer activities. As PPPL ORTA, he has championed partnering with small businesses to provide access to PPPL facilities and expertise to enable small businesses to contribute essential research and development that affects the quality of life. Under a CRADA he initiated, Ras Labs of Hillsborough, New Jersey, is developing a method to produce synthetic muscle tissue that would allow amputees and other injured people to regain lost control of limbs, hands and fingers through the use of the synthetic muscle tissue and prosthetic devices (you can read more about this partnership in the Spring 2007 issue of *FLC Northeast News*).

Jesse Erlich, Burns & Levinson, LLP Regional Appreciation Award

Jesse Erlich received the Regional Appreciation Award, which is presented to a non-government employee who has made a significant contribution to the federal technology transfer program. A partner at the Boston-based law firm of Burns and Levinson, LLP, Erlich is also a member of the Intellectual Property (IP)/SciTech, Government Contracts, and Science & Technology Groups. He represents a wide array of clients such as universities and technology companies of all sizes in diverse technological fields. Erlich has contributed to both the Northeast Region and the national FLC over many years. He is a valued advisor on issues regarding intellectual property, government contracts, SBIR programs and homeland security, and has shared his expertise at numerous training sessions at FLC regional and national meetings. In addition, Erlich has helped the FLC's Washington, D.C. office deal with IP-related legislation.

Erlich has contributed to numerous publications and has co-authored a book entitled *Technology Development and Transfer—The Transaction and Legal Environment*. He is also a contributor to the Aspen Law & Business 2000-2008 Licensing Update. A member of the faculty of Franklin Pierce Law School, Erlich has also sat on the faculty of the National Intellectual Property Law Institute and the Intellectual Property Institute for Corporate Counsel.

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NE Regional Awards (cont.)

U.S. Army Armament Research, Development and Engineering Center Regional Laboratory Award

The U.S. Army Armament Research, Development and Engineering Center (ARDEC) at Picatinny Arsenal, New Jersey, received the Regional Laboratory Award for its extraordinary efforts in national and regional technology transfer activities. The laboratory is a preeminent national and international leader in research, development, engineering and production support for defense armament systems. ARDEC partners with a wide variety of organizations, including industry, academia and other nonmilitary government organizations to accelerate the development and transition of new technologies for the warfighter. ARDEC's research investment has also demonstrated commercial spinoff benefits for the nation's civilian economy.

ARDEC has a robust technology transfer program with an ever-increasing number of partnership agreements. Currently it has over 160 active CRADAs, which are only one of many innovative partnering tools being used. In addition, ARDEC uses other tools to advance its technology transfer mission, including educational partnerships, patent licensing, and test service agreements, all in support of the FLC's mission.

"Advanced Diamond Wire Cutting System," Princeton Plasma Physics Laboratory Excellence in Technology Transfer Award

Researchers at the Princeton Plasma Physics Laboratory (PPPL) won an Excellence in Technology Transfer Award for their efforts to commercialize new techniques they developed for cleaning and cooling the cutting wire of a diamond wire saw.

Conventional methods for cleaning the springs and beads of diamond wire saws use water to clean and cool the wire. This is undesirable where tritium, which is radioactive, or other contaminants may be present. The new PPPL system uses pellets of carbon dioxide, a solid, to clear away particulate matter that may gather in the springs and on the beads of diamond wire. The method also provides for the cooling of the wire. Both the cutting speed and the life of the diamond wire are improved when the new technique is used. Additionally, a new brake and torque mechanism has been developed that minimizes wire failure and increases wire life. A remote control feature allows the wire to be controlled from a distance, which enhances operator safety. Also, a dust containment system reduces the amount of hazardous and toxic material that the cutting process may release into the environment.

It is anticipated that this new system can be used in concrete and metal cutting, including the decommissioning of nuclear reactors and other facilities containing hazardous materials. Two companies have licensed the technology for challenging cutting and machining applications of their own, and others have continued to inquire about it.

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NE Regional Awards (cont.)

***“Coyote Unattended Ground Sensor Network,” U.S. Army Armament Research, Development and Engineering Center
Excellence in Technology Transfer Award***

A team from the U.S. Army Armament Research, Development and Engineering Center (ARDEC) won an Excellence in Technology Transfer Award for their commercialization of the Coyote™ Unattended Ground Sensor (UGS) Network. The UGS is a state-of-the-art, joint sensor and communications system that is easy to deploy, resistant to security attacks, reliably scales from small focused targets to a nationwide network and, most importantly, is more cost-effective than less advanced sensing technologies. Though designed for border security and infrastructure monitoring, the increased safety for warfighters using the Coyote™ UGS is highly significant.

In 2007, Innovative Wireless Technologies (IWT), a Virginia-based company providing wireless sensor products and services for government and commercial customers, approached ARDEC with the idea that UGS technology also could be applied to other federal agencies and commercial needs. With years of cooperative efforts for this program between them, ARDEC and IWT were ideally suited partners. ARDEC's mission to develop engineering processes for munitions, weapons and associated items made it the most appropriate federal lab in which to advance the Coyote™ UGS Network.

The Northeast Region congratulates the winners on a job well done.

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Scientists Reveal Effects of Quantum “Traffic Jam” in High-Temperature Superconductors

Scientists at Brookhaven National Laboratory (BNL), in collaboration with colleagues at Cornell University, Tokyo University, the University of California-Berkeley, and the University of Colorado, have uncovered the first experimental evidence for why the transition temperature of high-temperature superconductors—the temperature at which these materials carry electrical current with no resistance—cannot simply be elevated by increasing the electrons' binding energy. The research—published in the August 28 issue of *Nature*—demonstrates how, as electron-pair binding energy increases, the electrons' tendency to get caught in a quantum mechanical “traffic jam” overwhelms the interactions needed for the material to act as a superconductor—a freely flowing fluid of electron pairs.

“We've made movies to show this traffic jam as a function of energy. At some energies, the traffic is moving, and at others the electron traffic is completely blocked,” said physicist J.C. Seamus Davis of BNL and Cornell University, lead author on the paper. Davis gave a Pagels Memorial Public Lecture to announce the results at the Aspen Center for Physics on August 27.

Understanding the detailed mechanism for how quantum traffic jams (technically referred to as “Mottness” after the late Sir Neville Mott of Cambridge, England) impact superconductivity in cuprates may point scientists toward new materials that can be made to act as superconductors at significantly higher temperatures suitable for real-world applications, such as zero-loss energy generation and transmission systems and more powerful computers.

The idea that increasing binding energy could elevate a superconductor's transition temperature stems from the mechanism underlying conventional superconductors' ability to carry current with no resistance. In those materials, which operate close to absolute zero (0 Kelvin, or -273 degrees Celsius), electrons carry current by forming so-called Cooper pairs. The more strongly bound those electron pairs, the higher the transition temperature of the superconductor.

But unlike those metallic superconductors, the newer forms of high-temperature superconductors, first discovered some 20 years ago, originate from nonmetallic, Mott-insulating materials. Elevating these materials' pair-binding energy only appears to push the transition temperature farther down, closer to absolute zero rather than toward the desired goal of room temperature or above. “It has been a frustrating and embarrassing problem to explain why this is the case,” Davis said. His research now offers an explanation.

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Quantum “Traffic Jam” (cont.)

In the insulating "parent" materials from which high-temperature superconductors arise, which typically are made of materials containing copper and oxygen, each copper atom has one "free" electron. These electrons, however, are stuck in a Mott-insulating state—the quantum traffic jam—and cannot move around. By removing a few of the electrons—a process called "hole doping"—the remaining electrons can start to flow from one copper atom to the next. In essence, this turns the material from an insulator to a metallic state, but one with the startling property that it superconducts—it carries electrical current effortlessly without any losses of energy. "It's like taking some cars off the highway during rush hour. All of a sudden, the traffic starts to move," said Davis.

The proposed mechanism for how these materials carry the current depends on magnetic interactions between the electrons causing them to form superconducting Cooper pairs. Davis's research, which used "quasiparticle interference imaging" with a scanning tunneling microscope to study the electronic structure of a cuprate superconductor, indicates that those magnetic interactions get stronger as holes are *removed* from the system. So, even as the binding energy, or ability of electrons to link up in pairs, gets *higher*, the "Mottness," or quantum traffic-jam effect, increases even more rapidly and diminishes the supercurrent's ability to flow.

"In essence, the research shows that what is believed to be required to increase the superconductivity in these systems—stronger magnetic interactions—also pushes the system closer to the 'quantum traffic-jam' status, where lack of holes locks the electrons into positions from which they cannot move. It's like gassing up the cars and then jamming them all onto the highway at once. There's lots of energy, but no ability to go anywhere," Davis said.

With this evidence pointing the scientists to a more precise theoretical understanding of the problem, they can now begin to explore solutions. "We need to look for materials with such strong pairing but which don't exhibit this Mottness or 'quantum traffic-jam' effect," Davis said.

Scientists at BNL are now investigating promising new materials in which the basic elements are iron and arsenic instead of copper and oxygen. "Our hope is that they will have less 'traffic-jam' effect while having stronger electron pairing," said Davis. Techniques developed for the current study should allow them to find out.

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Volpe Center Wins the Prestigious 2008 Innovations in American Government Award

The Ash Institute for Democratic Governance and Innovation at Harvard Kennedy School recently announced the Global Maritime Domain Awareness Program as a winner of the 2008 Innovations in American Government Award for its efforts to enhance levels of safety and economic stability on the global seas. Developed by the Volpe Center of the Department of Transportation's Research and Innovative Technology Administration, the program provides an unprecedented level of visibility into transit and port activity. The movements of more than 10,000 vessels from over 50 nations are tracked and updated in real-time. The program was honored at the Innovations in American Government Awards ceremony in Washington, D.C., on September 9, 2008, and will receive \$100,000 towards dissemination and replication across the country.

For more information on this year's recipients of the Ash Institute's 2008 Innovations in American Government Awards, visit http://ashinstitute.harvard.edu/corporate_site/innovations/innovations_winners/2008_iag_award_winners_announced.

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Pilot Project with Fishing Industry Seeks to Provide More Detailed Data on the Region's Fisheries and Environmental Conditions

For some commercial fishermen, flounders are not just a species of fish but a computer software system being tested aboard fishing vessels to record haul-by-haul data. The resulting electronic logbook system may one day replace paper logbooks in the New England groundfish fleet, providing near real-time information to improve stock assessments and fisheries science in the region.

The Study Fleet, a pilot project of the Cooperative Research Program at the National Oceanic and Atmospheric Administration's (NOAA) Northeast Fisheries Science Center (NEFSC), began by assembling commercial New England groundfish vessels willing to provide high resolution or haul-by-haul self-reported data on catch, effort, and environmental conditions while conducting normal fishing operations.

"The data these vessels can provide using FLOUNDERS (Fisheries Logbook Data Recording Software) is more accurate, detailed and comprehensive than would be obtained without deploying expensive observers who are part of the Northeast Fishery Observer Program," said Mike Palmer, a NEFSC fisheries biologist who coordinates the Study Fleet project. The data are available externally only in a form that ensures the privacy of individual operators.

"The fishermen send in their data near real-time to NEFSC using their vessel monitoring systems (VMS). The data are loaded to our databases and made available to fishermen via the Internet to view, edit and confirm in less than an hour after a fishing trip has ended," Palmer said. "This allows the industry to ensure that the data received by NMFS (National Marine Fisheries Service) are reported as they reported them. They have additional control and accountability for the fisheries data they collect."

Study fleet vessels are equipped with the computer software program, and the captains are trained on how to use the electronic logbook system, which includes a gear-mounted temperature-depth probe and a global positioning system (GPS) unit to track the precise time and location of fishing efforts. The temperature probe data, downloaded from the vessel once a month by project staff, enables scientists at NEFSC to investigate environmental conditions that may influence catch rates and provide clues to ecosystem-wide changes.

Developing and implementing an electronic logbook system to collect, transfer and store data at sea by fishers was field-tested aboard a variety of groundfish vessels during the first two phases of the study fleet project between November 2002 and August 2005. Approximately 1,100 trips were reported by 33 vessels using the system in the Gulf of Maine, Georges Bank, and Mid-Atlantic Bight.

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Pilot Project (cont.)

Phase three, which is ongoing, began in September 2006 with six vessels that had participated in phase two. All are groundfish vessels, but they also participate in the shrimp, squid and fluke fisheries. Vessels receive some financial compensation for their participation in the project.

Bill Lee, captain and owner of the fishing vessel (F/V) *Ocean Reporter* from Rockport, Mass., has been fishing for more than 38 years and involved in NOAA's Cooperative Research Program and the Study Fleet project from the beginning. "It is very important to have fishermen involved in the research about their industry," he said. "The only way we are going to get things to improve is to participate in the process. I get frustrated at times that things haven't moved further forward, but at least they are moving in the right direction."

Lee has embraced the use of technology and is also working with researchers from a number of organizations in New England on other marine-related research projects in the Stellwagen Bank National Marine Sanctuary and in the Gulf of Maine. "It is all about cooperation. Scientists need and want data about the ocean, and fishermen can help provide that," Lee stated.

Captain Dave Goethel of the F/V *Ellen Diane* from Hampton, N.H., agrees that being involved in the process is critical. "If we are going to manage the ocean, we need to understand it, and participating in programs like this helps me as a fisherman to understand what is going on. It also helps the scientists learn how fishermen do things, what knowledge and skills they have. Everybody learns."

A fisherman most of his life and with a biology degree from Boston University, Goethel has been captain of a boat since 1973 and, like Lee, has participated in the Cooperative Research Program and the Study Fleet project from the start. Although he admits he isn't very comfortable with computers, he says the study fleet system has gotten much easier to use, and he can see the benefits from the data being collected.

"Getting the environmental data back from NEFSC confirms what I have been seeing in terms of where the fish are," he said. "I can definitely see the trends. One degree change in water temperature can mean cod or another species you are fishing are not where you thought they would be. It isn't always intuitive, either. Sometimes it is colder in waters to the south that you think should be warmer. The data help fishermen understand why they are catching certain fish at certain places at certain times."

In January 2008, the Study Fleet project expanded into two data-poor fisheries: hagfish and tilefish. Palmer says the study fleets have the highest chance of improving stock assessments in data-poor fisheries where there is limited observer coverage and species are not sampled well by NEFSC surveys.

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Pilot Project (cont.)

Study Fleet data have been compared to existing fishery-dependent data collection programs used by the NMFS in the northeast region, and overall the data are similar to those collected by the Northeast Fishery Observer Program. Data were more accurate and precise than those provided by fishing vessel trip reports in terms of identifying the area of fishing and the duration of effort, and more timely because of the electronic collection and at-sea transmission.

“We need to build trust between fishermen and scientists,” Palmer said. “The industry has to trust the scientists enough to want to provide accurate data, and the scientists have to trust the industry enough to believe in the quality of the data.”

“This is a cooperative project with the fishing industry,” said John Hoey, a fisheries biologist and director of the NEFSC Cooperative Research Program. “Both sides can benefit from the data collected.” Hoey says that despite funding cuts in recent years, the Study Fleet project has been successful in developing, testing and deploying an electronic logbook system among the New England groundfish fleet.

The Cooperative Research Program, of which the Study Fleet project is a part, was established in 1999 by NOAA Fisheries to involve the fishing industry directly in planning and conducting studies that provide useful information for managing fisheries.

“Sometimes fishermen are surprised by the results from a cooperative research project, but they know they are accurate because they were there,” Goethel said. “The results speak for themselves. We need more efforts like this. There is a lot to be gained for everyone.”

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Northeast Region Fall 2008 Meeting Review

The fall 2008 Northeast Region meeting was recently held at Brookhaven National Laboratory (BNL) in Upton, New York. The three-day event, which took place September 16-17, included informative sessions on regional technology transfer activities, a tour of BNL, a networking reception, and presentation of the 2008 Northeast Region awards.

The meeting kicked off with a welcome message from Regional Coordinator Dr. Theresa Baus and BNL Laboratory Representative for the FLC Michael Furey. Following an update on Department of Energy technology transfer activities by FLC Agency Representative David Koegel, representatives of the Veterans Administration and the U.S. Geological Survey led presentations on their respective technology transfer efforts. Rounding out the day's presentations was an overview of Department of Homeland Security laboratories in the region, including the Environmental Measurements Lab; and the Department of Agriculture's Plum Island Animal Disease Center.

The afternoon session featured a tour of BNL that included visits to the Center for Functional Nanomaterials, a facility that provides state-of-the-art capabilities for the fabrication and study of nanoscale materials; the Center for Translational Neuroimaging Positron Emission Tomography, a facility that uses a network of brain imaging tools to better understand human behavior and treat brain diseases; and the National Synchrotron Light Source, a national user research facility that operates electron storage rings, which provide intense light spanning the electromagnetic spectrum from the infrared through x-rays.

Day one of the meeting was capped off with a reception at the American Air Power Museum at Republic Airport in nearby Farmingdale. The museum houses a squadron of operational World War II aircraft that are flown regularly to the delight of visitors.

The final day of the meeting included an update on procedural matters regarding the Region, as well as the presentation of 2008 Northeast Region awards. Proceedings of the meeting and a photo gallery are available for viewing at www.flcnortheast.org/.

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Prager to Lead PPPL

Dr. Stewart Prager, director of the Madison Symmetric Torus experiment at the University of Wisconsin and an internationally recognized leader in the field of fusion energy research, has been named director of the Department of Energy's (DOE) Princeton Plasma Physics Laboratory (PPPL), effective this fall.

Dr. Prager, who also is the Dexter Professor of Physics at Wisconsin, will become the sixth director of the laboratory, which is funded by the DOE and managed by the University. His appointment as a professor of astrophysical sciences at Princeton is expected to be acted on in the fall.

"We believe that there is no better person than Stewart Prager to lead the Plasma Physics Laboratory as it moves into the next phase in its distinguished history," said Princeton president Shirley M. Tilghman. "The need for safe, abundant and environmentally benign sources of energy has never been greater, and we are confident that under his leadership PPPL will continue to make exceptional contributions to the field of fusion energy."

Provost Christopher Eisgruber added, "Stewart Prager is not only a superb scientist, but also a proven leader of the nation's fusion research community. All of us at Princeton are absolutely delighted that Dr. Prager has agreed to take the helm at the laboratory."

Dr. Prager joined the Wisconsin faculty in 1977 after conducting research for two years with the Fusion Energy Group at the General Atomic Co. (now known as General Atomics) in San Diego. He is a pioneer in the field of plasma physics and is internationally known for experiments that have contributed to both fundamental knowledge and the design of future reactors.

Dr. Prager has made his name as an experimentalist in the quest to develop fusion energy, the energy that is released when atomic particles fuse together to form heavier particles. Fusion fuels the sun and other stars. Dr. Prager has played a key role for decades in efforts to harness the energy potential of nuclear fusion by working with charged gases known as plasmas.

On the Wisconsin "Levitated Octupole" experiment, Dr. Prager worked with a graduate student, Michael Zarnstorff, now a principal research physicist at PPPL, and detected for the first time the so-called bootstrap current, named because the electrical current is generated by the plasma itself. Dr. Prager and Zarnstorff will receive the American Physical Society's Dawson Prize for Excellence in Plasma Physics this November.

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Prager (cont.)

Dr. Prager has led research on another experimental device, the DOE-funded Madison Symmetric Torus, directing a group that was the first in the world to completely characterize the chaotic flow of the charged gases swirling within. Shaped like a donut, the MST holds plasma heated to 10 million degrees. But instead of using a strong magnetic field to hold the plasma, Dr. Prager and his team have explored whether weaker—and therefore more economical—magnetic fields could accomplish the same task. The work has led to new insights about the properties of plasma.

Experiments that help identify and understand such phenomena are critical to the eventual goal of producing commercially viable fusion power plants.

Dr. Prager also has led the Center for Magnetic Self-Organization in Laboratory and Astrophysical Plasmas. Funded by the National Science Foundation, the "physics frontier center" involves Wisconsin, Princeton and five other institutions.

In addition, Dr. Prager has provided exemplary service to the plasma physics community through his role on many prominent national panels and advisory committees. He has served as chair of DOE's Fusion Energy Sciences Advisory Committee, chair of the Division of Plasma Physics of the American Physical Society, president of the University Fusion Association, and a member of the fusion review panel of President Clinton's Committee of Advisers on Science and Technology.

Dr. Prager holds bachelor's degrees from Queens College of the City University of New York and from Columbia University. He earned his Ph.D. in plasma physics from Columbia.

Dr. Prager's appointment, which concludes an international search, comes at a time of transition for PPPL. At the direction of DOE, the lab is in the process of phasing out construction of the National Compact Stellarator Experiment (NCSX) and enhancing its flagship program, the National Spherical Torus Experiment (NSTX). This approach is intended to ensure the lab's future as a world-leading center of fusion energy and plasma sciences.

PPPL is one of ten national science laboratories funded by DOE's Office of Science. As the department completes a series of competitive bidding processes for the management and operations contracts for all of these labs, Princeton currently is competing for a new contract to continue managing the lab. The University has managed the lab successfully since its inception in 1951.

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Prager (cont.)

"In Stewart Prager we have recruited the very best person to lead PPPL. Not only does he bring superb scientific credentials, but also proven experience in management, and an outstanding record on the national fusion scene," said A.J. Stewart Smith, Princeton's dean for research, to whom Prager will report. "I simply could not be more enthusiastic."

Dr. Prager will succeed Dr. Robert Goldston, who has been director of PPPL since July 1997. Dr. Goldston, who also is a professor of astrophysical sciences, announced last December that he would step down as director when a successor was in place to focus on a broad range of domestic and international fusion energy initiatives.

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Enzyme Detectives at Brookhaven Uncover New Reactions, Products

If your experiment doesn't go the way you expect, take a closer look—something even more interesting may have happened. That strategy has led scientists at Brookhaven National Laboratory (BNL) to discover a fundamental shift in an enzyme's function that could help expand the toolbox for engineering biofuels and other plant-based oil products. The results were published online the week of September 8 in the *Proceedings of the National Academy of Sciences*.

The BNL scientists were trying to understand the factors that affect where carbon-carbon double bonds are placed in fatty acids, the building blocks of oils and fats, when they are "desaturated"—that is, when a desaturase enzyme removes hydrogen from the carbon chain. "Placing double bonds in different positions allows you to change the structure of the fatty acids to make products with different potential applications," explained BNL biochemist John Shanklin, who led the research. The ultimate goal: engineering designer plant oils to be used as biofuels and/or raw materials to reduce the use of petroleum.

To try to change the position of a double bond, the BNL team modified a desaturase enzyme, changing 3 of the 363 amino acids in its protein sequence. But when they tested the modified enzyme and looked for the expected product with its altered double-bond position, it wasn't there.

They could have moved on and made different amino acid changes to accomplish the initial goal. But BNL research associate Edward Whittle was determined to figure out what was going on with the unusual result. "The substrate, or starting material, had been used up, so something was being produced—substrates can't just disappear," Whittle said. "If it wasn't the product we were looking for, what was it?"

Whittle's detective work uncovered a remarkable discovery. Instead of producing a shift in the double-bond position, the enzyme modification had yielded three completely new products—two variations of a hydroxylated product called an allylic alcohol and a fatty acid containing two double bonds. "This was a profound shift in enzyme function," noted Shanklin, who has been working with modified enzymes for 15 years. "Usually you make changes very gradually, getting a few percent of a new product mixed with the original product. This was more like throwing a switch, making the change in function close to complete."

The discovery is also notable because the starting enzyme, like other soluble (membrane-independent) desaturases, can ordinarily perform only its one specified reaction—desaturation. This is unlike desaturase enzymes that reside within the cell membrane, which appear to be more versatile, performing a range of reactions. The soluble and membrane enzymes, however, do share one key feature: both perform reactions that require the production of a highly reactive form of oxygen.

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Enzyme Detectives (cont.)

“Since both classes of enzymes produce activated oxygen, in theory the soluble enzymes, like their membrane counterparts, should be able to perform a variety of reactions as well,” Shanklin said. “Our work demonstrates that this is indeed the case. Making small changes to the enzyme’s amino acid sequence has unlocked the soluble desaturase’s potential to facilitate a wider range of chemistry than has been seen before,” he added.

The challenge is to figure out how these structural changes to the enzyme lead to the observed changes in reaction chemistry. Computer-generated models combining the known structure of the starting enzyme in conjunction with its new substrates are helping the scientists understand how the enzyme works. The next step is to obtain real 3-D crystal structures of enzyme-substrate complexes, using the National Synchrotron Light Source at BNL, to see how they match up with the predictions.

Analyzing the structures of soluble enzymes is much simpler than obtaining structures for membrane enzymes. So, in effect, this work is a fast-track approach for correlating structure with function, which should help scientists gain general mechanistic insights relevant to both classes of enzymes. “Understanding how nature has figured out how to do this very difficult chemistry, and how to control that chemistry,” Shanklin said, “would be extremely satisfying from a purely scientific perspective. But applying this knowledge could have benefits for us all.

“Right now, the materials we use—the plastics, foams, nylons—have been limited by the structures of petroleum-based chemical feedstocks. But if we understand how to engineer designer desaturase-like plant enzymes, we can tailor-make feedstocks with optimal properties, instead of relying on the properties of preexisting raw materials,” Shanklin continued. “We’d no longer have to say, ‘this is what we have so this is what we can make.’ Instead, we could make the best feedstock for a particular application by designing the raw materials that will yield it.”

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Volpe Center Supports China's Growing Air Traffic Management Needs

In June 2008, Volpe Center representatives took part in a final program review of the Chinese Air Traffic Flow Management (ATFM) program in Beijing, China. The Center is part of the U.S. China Aviation Cooperation Program (ACP) ATFM team, which includes individuals from the Civil Aviation Administration of China/Air Traffic Management Bureau, Metron, the Federal Aviation Administration (FAA), the MITRE Corporation, Boeing, and Computer Sciences Corporation (CSC). Dr. Nelson H. Keeler, director of the Volpe Center's Office of Aviation Programs, serves as the senior U.S. government representative on the team.

ATFM is an important part of the Chinese aviation authority's response to the fast-growing demand for air travel and air cargo shipments. Volpe Center's participation in this program review is part of an ongoing relationship with Chinese colleagues who have previously visited the Volpe Center to learn about best practices for air traffic management and about the Enhanced Traffic Management System (ETMS). The Volpe Center is responsible for the development and daily operation of ETMS, the primary system used to support the FAA's mission to track, predict, plan air traffic flow; analyze the effects of ground delays; and evaluate alternative routing strategies. ETMS integrates weather and flight data from multiple sources and presents it in a graphical format, allowing the FAA to anticipate and balance air traffic flow across the national airspace.

ETMS initially focused on North American air travel, but is expanding into the international arena, both because the FAA needs an interface with international aircraft arriving in the U.S. and in response to the growing needs of emerging markets and developing economies.

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Picatinny Engineer Awarded Two Patents for New Grenade Ammunition Designs

On August 5, the U.S. Patent and Trademark Office issued an Armament Research, Development and Engineering Center (ARDEC) employee two patent approvals for new designs to be incorporated into the ammunition belt for the MK 19 grenade machine gun. The MK 19 40-millimeter (mm) grenade machine gun is used by all military services to deliver intense firepower against enemy personnel and lightly armored vehicles. The designs to be incorporated into the belt, which is called a 40-mm M16A2 link, are meant to keep gunners safer on the battlefield, help conserve ammunition, and save money.

ARDEC engineer Eric Goon designed the new concepts, the first of which is a coupling, or pivoting, used to connect grenade ammunition cartridge loops. The new coupling design provides a potential lifesaving feature. It allows MK 19 gunners to attach ammunition belts without having to reload the weapon when under hostile gunfire.

In the current attachment system, grenade ammunition comes in a continuous link of 32 grenades. The grenades cannot be detached, or reattached to other ammunition belts, unless they are cut or pried open. Therefore, if an MK 19 gunner needs more ammunition, he must open the feed cover to reload. With the new attachment, an assistant gunner could fasten another belt to the partial belt so that the weapon does not require reloading, thus saving time and potentially a warfighter's life.

The reattachment feature also allows military members to recover partially used clips and attach them to other ammunition belts for future use. This new reattachment feature provides a way of salvaging costly field ammunition that would be rendered useless or costly to recover with the current design. It is estimated that the coupling will save the Army more than \$2 million dollars per year in unused grenade rounds, which cost approximately \$40 per round.

The second patent invention is for a new method of making 40-mm one-piece loops for the grenade ammunition cartridge. The metal loop, which surrounds the individual grenade, is what the coupling will attach to in order to link the grenades together.

Currently, the loop comes in two parts and is bonded together using resistance welding. This welding, although effective, is seen as an undesirable operation because the welded sections could potentially rust over time, weakening the bond and threatening the integrity of the link. The approach taken for the invention is to eliminate the welds in their entirety, creating a solid one-piece loop. This new single-piece loop design offers a more durable product, a 15 percent weight reduction of the component, and a potential cost reduction of approximately 30 percent.

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Grenade Design (cont.)

Goon said he decided to improve the grenade ammunition link after a request from troops in the field who said they needed a reliable way to reuse ammunition through relinking the belts. He heard about the issue through an ARDEC engineer team deployed in battle zones to survey warfighters and gain feedback about complaints or technological deficiencies.

“When I heard about that I said, ‘Wait, we need to answer the call for the soldier, our customer,’ ” Goon said. “I said, ‘Let’s do something about it.’ ” He spent approximately six months designing the inventions.

Once incorporated, Goon said the new invention designs will not be noticeable to soldiers who use the product, except for the enhanced pivoting features. There will be no modification in the way the user handles the weapon system. “I didn’t want to change the whole system because it would be too costly,” Goon said. Instead, he enhanced the current system to make it more efficient. Troops could see the coupling device as early as fiscal year 2009 and the one-piece loop as early as fiscal year 2010.

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Scientists Integrate Data in Three Dimensions Across Coastal Seascapes to Study Climate Effects on Young Fish

From the surface, the two areas of ocean off the coasts of northern New Jersey and Long Island, New York, look the same. But to National Oceanic and Atmospheric Administration (NOAA) scientists, the four-square-mile patches could not be more different as they view real-time underwater images and environmental data to try to figure out what lives there and how climate change is affecting marine life, especially very young fish.

“These areas are much more dynamic than terrestrial landscapes and not what we are used to thinking about the ocean,” said John Manderson, a fishery biologist with NOAA’s Northeast Fisheries Science Center (NEFSC) at the James J. Howard Marine Sciences Laboratory in Sandy Hook, N.J. “People look at the ocean floor as the habitat, but don’t think about the connection with the water column above it and how ocean fronts, like atmospheric weather, move through to create a constantly changing environment that affects fish and other marine life. It is a seascape, a moving 3-D environment.”

Manderson and colleagues in the NEFSC’s Behavioral Ecology Branch recently completed their first two-week cruise to the study area for the 2008 Ecology of Coastal Ocean Seascapes (ECOS) project. Additional two-week cruises were conducted in July and September.

The goal of ECOS is to view the two seascapes in an integrated way using real-time data, focusing on the distribution and condition of early life stages of fishes, and to develop models to aid fisheries research and management. For example, the models could ultimately be used to support fisheries managers to make informed decisions regarding the importance of habitat type for managed fish species, and to help answer questions about the effects of climate change on the success of fish stocks.

One ECOS study site is south of the Hudson-Raritan River estuary and plume, the other about 20 kilometers (12 miles) north and east off Long Island. The scientists aboard NEFSC’s 50-foot research vessel *Nauvoo* for the first cruise were surprised by what they saw, especially the differences in bottom life in study areas just a few miles apart with similar bottom structure.

“Based on side-scan sonar data and other information, we selected two study areas that had similar sandy bottoms because we were towing a video camera close to the sea floor,” Manderson said. “You would think they would look similar on video because they were not far apart, but what we found was more temperate marine life species like fluke, anchovies and sea robins off New Jersey, and scallops, squid egg mops and winter flounder more typical of New England off Long Island. The differences in the two seascapes were striking.”

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Climate Effects (cont.)

Technology has been a huge help to the ECOS project. The *Nauvoo* is equipped with side-scan sonar, fisheries hydroacoustics, a Wi-Fi link to shore that receives real-time satellite and high-frequency radar imagery of data collected by a regional ocean observing system, GPS, an underwater video camera, and environmental sensors that measure water temperature, salinity and other conditions.

Each day during the two-week cruises, the team of six scientists and ship's crew headed out from the Atlantic Highlands Marina to the study sites, approximately 5 to 10 miles offshore. Working in depths up to 60 meters (about 100 feet), they used the various real-time data they received from above and below the surface to develop a track line or sampling route of the ocean floor within their study areas. They towed a small video camera sled, stopped at stations along the track to sample from the surface to the sea floor with a CTD (conductivity, temperature, density) recorder, and collected other environmental data. A beam trawl was used to collect specimens and to ground-truth the video imagery. Tissue and diet samples were collected from the animals and brought back to the laboratory.

“Right now we are characterizing the living marine resources and their habitats. We’re mainly interested in how the early life histories of fish affect the survival and productivity of the commercially and recreationally important species of our region,” Manderson said. “We hope to expand the studies to examine habitat effects on growth and mortality and the reproduction of adults. We will also be developing integrated laboratory and field experiments, allowing us to model distribution of species, recruitment of year classes, and other useful information.”

Manderson noted the ECOS project, funded by NOAA, is a step forward in coastal fisheries research because it is looking at fish habitats holistically and dynamically in areas close to shore that have not been well studied.

“We’re using a variety of real and near real-time data that integrate information and present a three-dimensional view of the environment,” he said. “We’re able to move with a moving ocean, sampling with advanced technology and seeing it as it happens so we can adjust our sampling strategies as necessary. It is exciting to think of the possibilities.”

The ECOS team had another surprise during their first cruise, but not a scientific one. As they returned home from a day's work on June 9, they spotted what appeared to be ducks bobbing on the surface just ahead of them near the entrance to the Atlantic Highlands Marina. It wasn't ducks, but three teenagers whose small rowboat had swamped. Two were clinging to the overturned boat; the third had drifted away but was nearby.

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Climate Effects (cont.)

Officer-in-Charge Amanda Goeller and Mate Peter Plantamura maneuvered the *Nauvoo* into position for a rescue, lowering the swim ladder so the two males on the overturned boat could swim to the vessel. Once safely on board, the crew pulled up the ladder and moved into position to recover the third person nearby, then recovered the 12-foot aluminum boat by hoisting it onto the deck with the vessel's A-frame and winches.

The three young men, apparently fishing, were unhurt and thankful for the help from the *Nauvoo*. Once into port, the trio left with their boat, and promised to wear life jackets next time.

Those who operate NOAA research vessels, including the *Nauvoo*, are commissioned officers of NOAA Corps, one of the nation's seven uniformed services.

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Lynn Murray Retires from Volpe Center

Lynn Murray, head of the Communication and Technology Outreach Division at the Volpe National Transportation Systems Center, retired from her post in August. During her tenure at the Cambridge, Massachusetts-based laboratory, she served as chair of the Department of Transportation's (DOT) Technology and Innovation Committee and as DOT representative to the Interagency Working Group on Technology Transfer; provided oversight for DOT's Small Business Innovation Research program; and was President-elect and board member of the Association for Federal Technology Transfer Excellence. Murray also was editor of the *Volpe Journal*, and was responsible for Volpe's communications activities. She also served for two years as the Vice-Chair of the Board of Directors of the Cambridge Chamber of Commerce.

Murray was also a member of the FLC, sitting on its Executive Board as well as serving as the chair of the Education and Training Committee since 2001. She has also received regional and national FLC recognition, winning both the Northeast Regional Coordinator's Excellence Award in 2002 and the FLC Laboratory Representative of the Year award in 2003.