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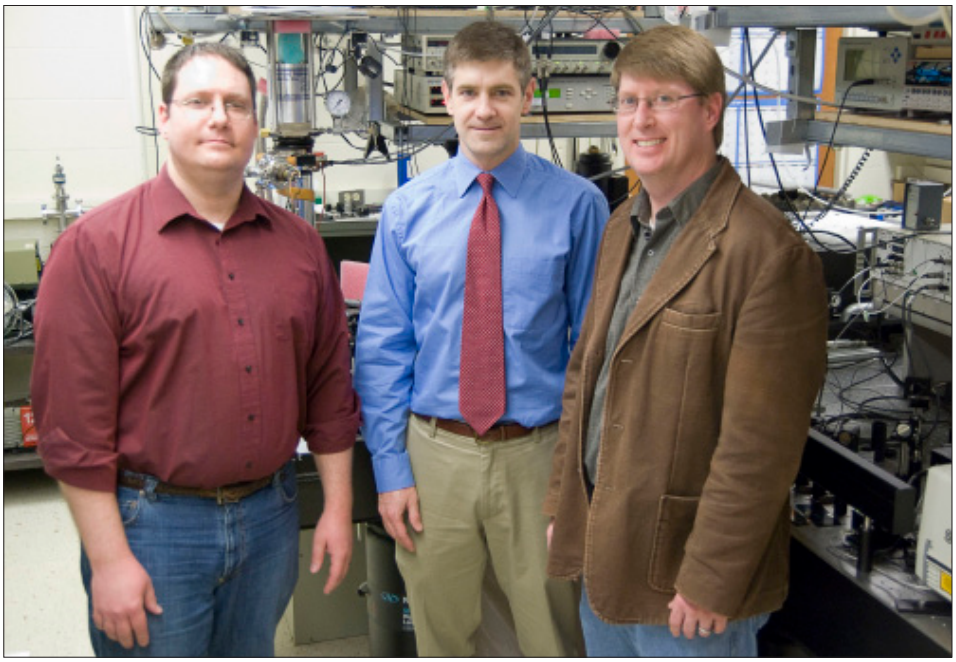

(L to R) Drs. Eric Stinaff, P. Gregory Van Patten and Jeffrey Rack are three of the five co-Principal Investigators on a recent National Science Foundation instrumentation grant. Photograph by Lydia Deakin.

Spectrometer facilitates NQPI research

In the amount of time it takes for light to travel a mere one third of a micrometer, one femtosecond has already come and gone. Clocking in at one billionth of one millionth of a single second, a femtosecond is measured as 10^{-15} seconds.

Although a femtosecond doesn't last very long, there's a lot going on at this timescale. Investigations at a femtosecond resolution can reveal key details behind phenomena that nanoscientists have yet to fully understand, including the energy dissipation process, the photochemical event of vision and the change in an electron's properties.

"You're looking at timescales in which electrons relax inside nanostructures, where spins interact," said Eric Stinaff, assistant professor of physics. "How do charges relax and get into their final state? That's still an open question."

To help understand these processes, the National Science Foundation recently awarded five researchers $400,000 for a new ultrafast transient absorption spectrometer.

The grant's co-Principal Investiga-

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Scientists study enzymes in plant cell wall structure

A plant's cell wall is the reason a plant looks the way it does. It creates form and acts as the first line of defense against harmful bacteria and fungi. Although the cell wall is a fundamental component of a plant, key aspects of this extracellular structure are still undiscovered.

Scientists know the plant cell wall is a matrix produced by thousands of enzymes, each one helping to construct the wall's web-like structure by synthesizing various polysaccharides and glycoproteins. But in most cases, researchers still don't know which enzyme adds which sugar during this web-building process.

Ohio University researchers are working to identify the enzyme responsible for adding the first sugar in one of the plant cell wall's glycoproteins, the Arabinogalactan-Protein (AGP). The National Science Foundation awarded the team $261,206 for the study.

Research has already shown that material from the plant cell wall can be converted into biofuel through microbial fermentation. Still, scientists lack the understanding needed to optimize this process, said Allan Showalter, pr-

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Director's Corner

Institute gains action committee, vies for new building

Dear Colleague,

Founded in 2001, NQPI is now in its tenth year, and all signs indicate that it is doing very well. In the last six months, new exciting high-profile publications have appeared, members have continued to compete successfully for new grant funding, and the Institute has continued to grow (currently to 28 members). The GERB project is also well underway in both its educational and research activities.

Recently, I formed a body called the GNAC (GERB/NQPI Action Committee) with representatives from physics, engineering and chemistry. GNAC met for the first time in January to discuss next steps for NQPI. Among them is to continue competing for a dedicated research building; this plan is closer to fulfillment now than ever, as our recent 2009 NIST proposal for construction funding received very high marks. We will be constantly on the lookout for new funding opportunities in order to realize this major goal.

The installation of the helium liquefier is also progressing, with an estimated turn-on date for the system set for late spring. Both the gas recovery pipelines and the electrical power installations are in progress.

-Art Smith, Director

NANOBYTES

Dr. Horacio Castillo received a $103,539 grant from the U.S. Department of Energy for "Fluctuations in the Dynamics of Glasses."

A team of researchers led by Dr. Saw-Wai Hla discovered the world's smallest superconductor in a study published by *Nature Nanotechnology* in March.

Dr. Gerardine Botte, associate professor of chemical and biomolecular engineering, and Dr. Eric Masson, assistant professor of chemistry and biochemistry, joined NQPI.

Briefs: NQPI news

Dr. Paolo Ferriani from the Institute of Theoretical Physics and Astrophysics at the University of Kiel presented an NQPI seminar titled, "Understanding the Magnetism of Singular Magnetic Atoms at Surfaces from First Principles."

Graduate student **Kendal Clark** received the Ovshinsky Student Award from the American Physics Society Division of Material Physics.

Graduate student **Kangkang Wang** and undergraduate communications student **Alyse Zimmer** traveled to the University of Hamburg this spring as part of the SPIRE study abroad program.

Dr. Noboru Takeuchi of the National Autonomous University of Mexico, Ensenada will be a visiting professor in the physics department during fall quarter 2010. Dr. Takeuchi will be working closely with the Sandler and Ulloa research groups.

The 5th Annual **NQPI Retreat** took place on April 16 and 17 at the Carpenter Inn Bed & Breakfast in Pomeroy, Ohio.

Researchers collaborate with NQPI groups during winter quarter visit

L to R: Professor Luis Rosales of Pontificia Universidad Catolica de Valparaiso, Chile; Professor Nancy Sandler of Ohio University; Professor Andrea Latge of Universidade and Federal Fluminense, Niteroi, Rio de Janeiro, Brazil; and Professor Sergio Ulloa of Ohio University. The researchers collaborated with the Ulloa and Sandler research groups during their stay at OU.

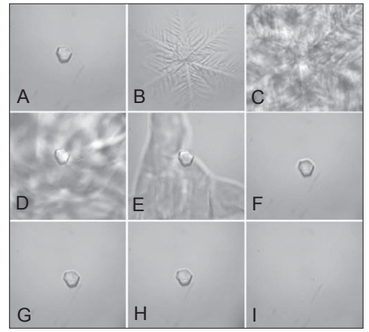
Graduate's PhD research published in PNAS

Yeliz Celik, who recently earned her doctoral degree in physics, was first author on a study published in *Proceedings of the National Academy of Sciences* (PNAS) this month. Dr. Ido Braslavsky from Ohio University and Dr. Peter Davies of Queen's University in Canada led the study.

The same antifreeze proteins (AFP) that keep organisms from freezing in cold environments also can prevent ice from melting at warmer temperatures, according to the research study.

AFP protect organisms that survive cold temperatures by arresting ice crystal growth within their bodies. Twenty years ago, researchers proposed that AFP can also function to suppress ice melting at temperatures higher than the equilibrium melting point — a phenomenon called superheating.

The team's study, supported by the National Science Foundation and the Canadian Institutes for Health Research, presents the first direct measurements of the superheating of ice crystals in AFP solutions, Celik said.



Sequence of a FH and MH experiment in a drop of MpAFP solution. (A) A single ice crystal grown in 36 μM MpAFP solution was stable down to −1.87 °C below melting point. (B) Dendritic growth indicating sudden growth of ice at this supercooling. (C) Growth continued until most of sample was frozen. (D–E) When frozen sample was warmed to close to melting temperature, all the ice melted except for initial crystal. (F) Remaining crystal was slowly warmed further. (G) Ice crystal remained stable at superheatings of up to 0.18 °C above Tm for over 25 min. (H) The crystal remained stable for 5 s at 0.18 °C before rapidly melting (I) in a 0.14 s time interval, with a velocity of 48 μm⁄s.
[Figure adapted from Celik et al. PNAS. Early Edition 9 March 2010.]

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-tors are Drs. Tadseuz Malinski, Jeffrey Rack, P. Gregory Van Patten and Jennifer Hines, from the department of chemistry and biochemistry; and Eric Stinaff, from the department of physics and astronomy.

The spectrometer operates like a strobe light. After a molecule is hit with one laser, another pulse of light is sent through. The delay between the two beams is at a femtosecond resolution, allowing researchers to observe changes in the sample that happen during this ultrafast timeframe.

The device is adaptable to many different experiments because it has a large range of excitation and detection wavelengths, Rack said. He added that students will also be trained to use the spectrometer.

"There's a lot of interesting chemistry and physics to be done at the femtosecond time scale," Stinaff said.

PLANT CELL WALL, from pg 1

incipal investigator, professor of plant biology and NQPI member.

"The primary goal is to better understand how the plant cell wall is put together," he said. "But if we can understand how to modify this particular enzyme, it may influence the ability to remove lignin from the cell wall to get to the cellulose you need for biofuel production."

The OU researchers — Drs. Showalter, Marcia Kieliszewski and Ahmed Faik — have determined that the first sugar in the plant cell wall, a galactose residue, binds to the AGP at the location where the amino acid Hydroxyproline (HYP) appears within its sequence. The team is now working to determine which enzyme or enzymes attach the galactose to HYP.

The team uses two techniques — proteomics and bioinformatics — to help make this determination. The researchers have whittled down the list from thousands of enzymes to six strong candidates.

With proteomics, the researchers determine the amino acid sequences of numerous proteins contained in the cell membrane fractions associated with the transfer of galactose.

Scientists grow Arabidopsis at OU. The genes in this plant are fully sequenced, making it a useful tool for the team's research.

The next step is to identify corresponding genes and predict which genes will likely produce proteins that are targeted to the Arabidopsis plant's Golgi apparatus and that transfer galactose.

One reason to use Arabidopsis is that all its genes have been sequenced, said Showalter. This means researchers know all the protein sequences, making the plant "essentially a library that can be searched."

The other method, bioinformatics, lets the team compare plant wall enzymes to enzymes that perform similar roles in animals and other organisms. Specifically, they can search for protein domains associated with binding and transferring galactose residues.

Once they have selected candidate enzymes, the team tests each one in an assay. The researchers mix a HYP-containing AGP peptide with a radioactive version of galactose and then add the candidate enzyme to the reaction. After a two-hour incubation period, the scientists can determine whether the peptide is labeled with the galactose.

Team studies drug for potential pancreatic cancer treatment

The American Cancer Society estimates that of the 42,470 people diagnosed with pancreatic cancer last year, only about one in five will live one year or longer after the cancer was found. Scientists have yet to discover a cure for this disease, and its standard treatment, gemcitibine, only extends a patient's life expectancy by a few weeks.

With a $2.6 million grant from the National Institutes of Health, Interthyr Corporation and Ohio University researchers are working to develop a drug that could potentially treat the disease.

"Receiving this grant is a significant step forward," said Dr. Doug Goetz, professor of chemical and biomolecular engineering and NQPI member. "The goal is, develop a safe therapeutic for this devastating disease."

Dr. Leonard Kohn — Interthyr Corporation CEO and retired OU faculty member from the College of Osteopathic Medicine and the Edison Biotechnology Institute — will collaborate with an interdisciplinary group of OU faculty led by Doug Goetz. The team includes Drs. Kelly McCall, Steve Bergmeier, Mark McMills, Frank Schwartz and Ramiro Malgor.

When bacteria enter the human body, particles shed from the bacteria bind to Toll-like receptors (TLR). TLRs trigger an innate immune response that protects the body from harmful bacteria.

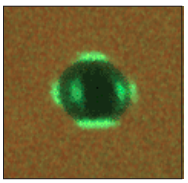
But what happens if this process occurs when it shouldn't? That question led Kohn to apply a derivative of a compound currently used in thyroid disease treatment to pancreatic cancer.

Pancreatic cancer cells and some other non-immune cells have been shown to have inappropriate TLR signaling. Instead of jump-starting the immune process, this signaling may result in inappropriate cell growth, the generation of inflammatory proteins and overall disease expression, Goetz said.

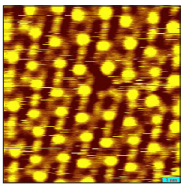
The idea is to treat pancreatic cancer with compounds that would inhibit unwanted TLR signaling, he said. Work led by McCall has already shown that the compound, C10, decreases TLR signaling in cancer cells.

NanoGallery

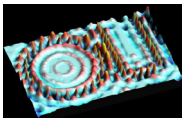
NQPI faculty share nano images from their labs



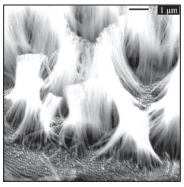
Ice crystal covered with fluorescence antifreeze proteins. Adapted from *Biophysical Journal, 2008, 95 (1) 333-342.* Braslavsky lab.



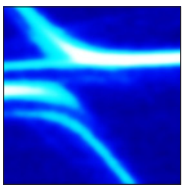
STM image of GaN c(6x12). Smith lab.



World's smallest 'OU,' made of 51 silver atoms on a silver surface. Hla lab.



~40 nm gold nanowires deposited electrochemically on nanoporous alumina templates. Kaya lab.



Spectroscopic signature of a charged molecular excitonic state in coupled quantum dots. Stinaff lab.

Design & writing by Emily Hubbell. Editing by Dr. Eric Stinaff and Robin Donovan. Please email nqpi@ohio.edu with comments.

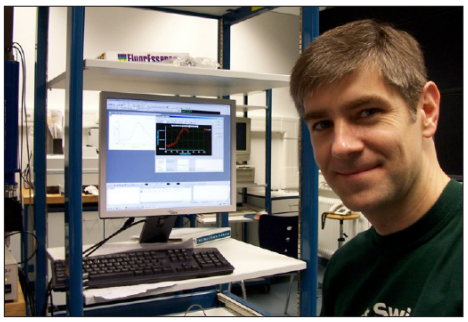
Scientists spend sabbaticals in Germany

Drs. Saw-Wai Hla and P. Gregory Van Patten recently returned from research sabbaticals in Germany.

Hla was a visiting professor of chemistry and physics at the University of Hamburg, where he collaborated with the Wiesendanger group on two topics — molecular magnets and magnetism at the atomic scale — and conducted research with the university's spin-polarized Scanning Tunneling Microscope.

He also supervised Ohio University students from NQPI's SPIRE program and collaborated with researchers at the University of Toulouse in France on the development of nanomachines.

Van Patten spent most of his year at the University of Hamburg synthesizing luminescent nanoparticles in collaboration with the Weller group.



Dr. P. Gregory Van Patten explored biological imaging in Hamburg.

The researchers worked to develop luminescent nanoparticles useful for biological imaging, Van Patten said.This involves synthesizing particles that are stable, as luminescent as possible, at the infrared wavelength.

The Alexander von Humboldt Foundation supported Van Patten's research in Germany.

Institute thanks events coordinator, reporting intern

Since summer 2007, Ms. Mala Braslavsky has served as NQPI's first Special Events & Outreach Coordinator. In June, she will be leaving NQPI to pursue new vistas with her family in Israel.

Mala's activities included developing the NQPI Web site into a dynamic vehicle of up-to-date information, administrating the NSS-5/SP-STM-2 conference (2008), helping launch NQPI's bi-annual newsletter, organizing the NQPI spring retreats, communicating with members on diverse topics, and much more—she will be greatly missed. Mala, we sincerely thank you for your hard work and wish you the very best.

NQPI would also like to thank Emily Hubbell for all her hard work and dedication as the NQPI journalism intern during the past two years. Best wishes in pursuing your career, Emily!