Protein viewer unveiled

Sasha Brown News Office

Last week, 200 high school biology students on a field trip to campus became the first to use a new 3-D protein database viewer that was created at MIT and will soon be available to schools nationwide.

The viewer was created by researchers in three different MIT departments, including Professor Graham Walker of biology, who used part of a $1 million Howard Hughes Medical Institute grant to form the HHMI Education Group, a research group dedicated to training science educators and developing tools and curriculum to improve introductory biology courses.

“Proteins are three-dimensional entities and we need to understand them that way,” Walker said. But the professional viewers available were “powerful but complicated to use,” he said. The ones made for educational purposes were “much more limited in their capabilities,” but still difficult to use.

In recent months, members of the HHMI Education Group collaborated to create the new protein database viewer using an educational tool developed several years ago at the MIT Center for Educational Purposes.

See PDF VIEWER

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Fiery debris disk linked to strange new planets

Deborah Halber News Office Correspondent

Cutting the first direct evidence that the fiery debris of a dying star may swirl around long after the star is obliterated, MIT astrophysicists report in the April 6 issue of Nature that this orbiting disk of debris could also lead to the birth of strange new planets.

This first-of-its-kind observation of a disk of debris around a long-dead star, made with NASA’s infrared Spitzer Space Telescope, could be the long-sought missing link behind the existence of the first planets discovered outside our solar system. In 1992, three Earth-sized planets were observed circling an exploded star called a pulsar. The MIT finding confirms what researchers had surmised from indirect evidence: These exotic planets were probably formed out of a dusty debris disk.

“When the planetary system around the pulsar was discovered, people generally agreed that the planets were probably formed from a disk,” said lead author Zhongxiang Wang, a postdoctoral fellow with the MIT Kavli Institute for Astrophysics and Space Research.

Yet searches for disks around old pulsars proved fruitless — until now. “Our work, the discovery of such a disk, strongly supports the suggestion that planets form around pulsars from residual disks,” Wang said.

“Pulsars emit a tremendous amount of high-energy radiation, yet within this harsh environment, we have a disk that looks a lot like those around young stars where planets are formed,” said principal investigator Deepa Chakrabarty, associate professor of physics with the MIT Kavli Institute.

Evidence for fallback

Massive stars more than 10 times the mass of the sun end their lives in supernova explosions. These dying stars collapse into a functional electronic device.

The goal of the work, led by MIT Professors Angela Belcher, Paula Hammond and Yet-Ming Chiang, is to create batteries consist of two opposite electrodes — an anode and cathode — that can be layered between charged, they can be layered between oppositely charged polymers to form thin, flexible sheets.

And because these viruses are negatively charged, they can be layered between oppositely charged polymers to form thin, flexible sheets.

The result? A dense, virus-loaded film that serves as an anode. A report on the work was published in the April 6 issue of Science.

Belcher, the Germeshausen Professor of Materials Science and Engineering and Biological Engineering, Chiang, the Kyocera Professor of Materials Science and Engineering (MSE), and Hammond, the Mark A. Yaman Professor of Chemical Engineering (CHEN), led a team of five additional researchers.

They are MSE graduate students Ki Tae Nam (the lead author), Dong-Wan Kim, Chung-Yi Chiang and Nonglak Meethong, and CHEN postdoctoral associate P.J. Yoo.

In their research, the MIT team altered the virus’s genes so they make protein

MIT scientists have harnessed the construction talents of tiny viruses to build ultra-small “nanowire” structures for use in very thin lithium-ion batteries.

By manipulating a few genes inside these viruses, the team was able to coax the organisms to grow and self-assemble into a functional electronic device.

Specifically, they manipulated the genes in a laboratory strain of a common virus, making the microbes collect exotic materials — cobalt oxide and gold.

And because these viruses are negatively charged, they can be layered between oppositely charged polymers to form thin, flexible sheets.

People

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CANCER WEAPON
MIT researchers report on how nanoparticles can be designed to deliver chemotherapy to cancer cells.

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Researchers employ viruses to build tiny batteries

From left, Professors Yet-Ming Chiang, Angela Belcher and Paula Hammond display a virus-loaded film that can serve as the anode of a battery.

This false-color image from three of NASA’s Great Observatories provides one example of a star that died in a fiery supernova blast. At the center of this orb, visible only as a tiny turquoise dot, is the leftover corpse of the now-dead star, called a neutron star. The multi-headed shell outside the neutron star is the rest of the original star’s scattered remains.

Researchers believe that the supernova
Philip Khoury named associate provost

Sasha Brown
News Office

MIT Provost L. Rafael Reif today announced that Philip S. Khoury, the Kenan Sahin Dean of the School of Humanities, Arts and Social Sciences, has been named associate provost of MIT, effective July 1.

Khoury succeeds Professor Alan Brodsky, who announced earlier this year his intention to step down as associate provost to focus on his role as a full professor and director of the Exploding Communications Industry Lab at MIT.

In addition to his responsibilities for the arts, Khoury will work to strengthen major interdepartmental educational, research and community-based initiatives, help to develop and implement a strategic plan for MIT’s international initiatives, and coordinate MIT’s efforts to promote and enhance deeper public discourse on questions of science, technology, society and policy.

“I am delighted that Professor Khoury has agreed to take on these new responsibilities following his exceptional 15-year tenure as dean of humanities, arts and social sciences,” said Reif.

“I am delighted that Professor Khoury has agreed to take on these new responsibilities following his exceptional 15-year tenure as dean of humanities, arts and social sciences,” said Reif.

Auditorium. The event is free and open to the public.

Sloan plans live public interview of Comcast CEO

Sarah H. Wright
News Office

Kevin Maney, senior technology writer and columnist for USA Today, will talk with Comcast CEO Brian Roberts in a live interview to be held on Wednesday, April 19, at 6:30 p.m. in Wong Auditorium. The event is free and open to the public.

The Sloan School of Management organized and is hosting the face-to-face meeting between Maney and Roberts, who is credited with transforming a minor Philadelphia cable company into a major media powerhouse.

Maney will interview Roberts on how he got where he is — including how his company expanded to include ownership of the Philadelphia Flyers NHL hockey team, as well as how he imagines the future for Comcast and the rest of the global media industry.

Under Roberts’ leadership, Comcast grew into a Fortune 100 company with 80,000 employees. Roberts is also chair- man of the board of directors of the National Cable & Telecommunications Association (NCTA) and previously served as chairman of NCTA from 1995 to 1996, when the landmark deregulatory 1996 Telecommunications Act became law.

Roberts was a founding co-chair of Phil- adelphia 2000, the local奥运 host com- mittee for the 2000 Olympic Games. An All-American in squash, he earned a gold medal with the U.S. squash team in 2005 and silver medals at the 1981, 1985 and 1990 Macabiah Games in Israel.


Robert Armstrong, Chevron Professor and head of the Depart- ment of Chemical Engineering, has been awarded the 2006 Bingle- ham Medal.

The Bingleham Medal is awarded by the Society of Rheology, which is devoted to the study of the science of deformation and flow of matter.

Armstrong, whose research interests include rheology as well as polymer molecular theory, polymer fluid mechanics, multiscale process modeling, transport phenomena and applied mathematics, will deliver a lecture and receive the award at the society’s annual meeting in Portland, Maine, in October.

Armstrong receives Bingham Medal

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Scolnick Prize winner to talk at Government

The McGovern Institute will present the third annual Edward M. Scolnick Prize in Neuroscience to Michael Greenberg, a world leader in molecular neurobiology from Children’s Hospital/Harvard Medi- cal School.

The Scolnick Prize provides an impor- tant arts focus for the intellectual and educational opportunities for the arts and social sciences community by calling attention to the best new approaches to understanding the brain. Greenberg was a guest public lect- ure titled “Connecting Signals That Control Synapse Development and Cogni- tive Function” from 4 to 5 p.m. on April 25 at the McGovern Institute, located in the Brain and Cognitive Sciences building at 43 Vassar St.

Greenberg directs the Program in Neu- robiology at the Children’s Hospital/Har- vard Medical School Department of Neu- rology. He has made seminal discoveries that have resulted in entirely new avenues of investigation in neural development, the neural response to injury and disease, and the search for new treatments for neuro- logical disorders and mental retardation.

“Dr. Greenberg exemplifies the inter- section of basic neuroscience research with areas of clinical importance, which will clearly impact the effort to alleviate the human suffering brought on by brain diseases,” said Robert Desimone, director of the McGovern Institute. “Many labora- tories worldwide are pursuing new leads based on the discoveries Dr. Greenberg has made.”

“I am honored to be selected,” said Greenberg. “It is especially meaningful to me because much of my research on signal- ing mechanisms that control nervous sys- tem development is based on by approaches that Dr. Scolnick developed for studying signaling pathways that regulate cell proliferation and survival.”

The S$50,000 prize is named in honor of the former president of Merck Research Laboratories, who held the company’s top research post for 17 years. The prize is endowed by a generous gift from The Merck Company Foundation to the McGovern Institute for Brain Research.
Nanoscience rising up to meet energy challenge, Dresselhaus says

Deborah Halter

Tiny materials may bring about large-scale change in electric energy, says MIT Professor Mildred S. Dresselhaus, who spoke at MIT Tech Talk Wednesday, April 5, at MIT and at the Technion Israel Institute of Technology.

In a talk addressing Grand Energy Challenges Through Nanoscience, Dresselhaus related how she became involved in 2003 in making hydrogen a more viable fuel source when she chaired a national study looking at the problem.

President Bush’s 2003 State of the Union announcement of a hydrogen fuel initiative substantially increased interest in the potential for hydrogen to play a major role in the nation’s long-term energy future.

While hydrogen has advantages, it’s “not a fuel. You can’t mine it. We would have to make nine million tons a year, and eventually, 20 times more than that,” Dresselhaus said.

Because hydrogen is currently produced from fossil fuels, scientists would have to find a way to reduce it from sustainable sources such as rainfall and ocean water.

“We need to develop the technology to convert hydrogen and water to free hydrogen, but we don’t know how to do it cheaply and at a large scale,” she said.

To make hydrogen that works as well as gasoline as an automotive fuel or to power the fuel cells that may replace internal combustion engines, researchers are depending on nanotechnology.

“By using new advanced materials now becoming available through nanoscience, scientists can take advantage of quantum phenomena that occur at this scale,” said Dresselhaus.

Nanotechnology can help develop efficient methods for hydrogen production and storage. Several chemical species contain hydrogen in high concentrations, but the trick is to release hydrogen from its strong chemical bonds to make it usable in a fuel cell, Dresselhaus said. Researchers are developing techniques to take advantage of nanoscale phenomena.

“I have to make it usable in a system like a car that needs a steady flow of fuel. How do you do that? Promising avenues have drawbacks — nasty by-products or high temperature requirements — but Dresselhaus is confident that these will be eliminated in time. ‘Each one of these things we know it in principle, but we’re far from knowing the details,’ she said.

Dresselhaus said significant change is unlikely to come about through incremental innovation alone, citing just as Edison’s incandescent light bulb was not born from improving the candle, future technologies are likely to bear little resemblance to today’s tried-and-true methods.

The talk was part of a monthly lecture series sponsored by Hibur, an MIT-Hillel-led program started by students with Danziger and Ivica Ceraj of Informatics Systems Division.

“Professor John Belcher and his research team joined forces with Danziger and Ivica Ceraj of Informatics Systems and Technology (IS&T) to develop a tool, the Technology Enhanced Active Learning Simulation Environment (TEALsim), which was designed by Andrew McKinney, Phillip Bailey and Michael Donage. It uses computer graphics to simulate physics problems, making them easier for students to visualize and understand, said Professor John Belcher of physics.

PDB VIEWER

Continued from Page 1

Computing Initiatives for the MIT physics department. That tool, the Technology Enhanced Active Learning Simulation Environment (TEALSim), was designed by Andrew McKinney, Phillip Bailey and Michael Donage. It uses computer graphics to simulate physics problems, making them easier for students to visualize and understand, said Professor John Belcher of physics.

"The PDBViewer was designed for the PDBViewer in the TEAL classroom in the basement of the Stata Center on Friday, March 31.

The PDBViewer was unveiled to the PDBViewer in the TEAL classroom in the basement of the Stata Center on Friday, March 31. On March 30 and 31, students from eight area high schools came for a science field trip, which Walker’s group has run annually since 2003 during the MIT spring break. High school students tour labs, attend lecture and participate in lab work led by graduate students.

Last year, the students attended a lab run by an older proton views. Their teachers remembered the problems they had with that program and this year they raised the new PDBViewer. "This is such a gorgeous program," said Mary Aguirre, a biology teacher at Hudson High, who was jumping up and down with excitement. "It gives you such an amazing visual of what is going on.”

Working in pairs, the high school students spent an hour on a tutorial program, first looking at the structure of the protein hemoglobin. By clicking the mouse, they could rotate the hemoglobin molecule, move it up and down, and zoom in on specific areas. They were able to quickly answer questions about the shape and structure of hemoglobin. Although they worked steadily, few students raised their hands with questions — a huge change from last year, said Melissa Kosinski-Collins, a postdoc.

Wearable sensors, many of which look like they’re straight out of gadget-casting for Xenon, Girl of the Future, promise profound and potentially life-saving changes in health care.

DEMONSTRATIONS overflowed from around the world, including Health4Gear, an implant containing a 10-micron-thick microelectrode array could restore a “useful level of vision” to patients suffering from macular degeneration.

Other presenters on clinical applications showed how sensors applied to the arm can assess the abilities and progress of people recovering from strokes; how a wearable sensor network could monitor postoperative recovery; and how a wireless sensor system might aid in treating dyskinesia, the involuntary writhing movements associated with Parkinson’s disease.

Wearable sensors, many of which look like they’re straight out of gadget-casting for Xenon, Girl of the Future, promise profound and potentially life-saving changes in health care.

Ask most Americans where their electricity comes from and they’ll say, “From the wall.” They don’t tend to think about the country’s energy infrastructure or how a hurricane or terrorist attack could disrupt the power grid. The Electric Power Research Institute (EPRI) is thinking about these things. The institute was created after a massive 1965 blackout in the northeastern United States revealed the vulnerability of the nation’s electric grid. EPRI, not a government agency and not an arm of the utilities, develops technology and solutions — a critical objective that raises awareness as an objective outsider that raises awareness and eventually it will conduct risk analysis of the terrorist vulnerability of 17 sectors, including liquified natural gas, subways, water supplies, dams and the power grid. The EPRI will advise the Department of Homeland Security on where to allocate funds to best protect these facilities.

Surprisingly, the institute has found that some plants have a low terrorist risk, “he said, because of the nature of their design and the fact that few nuclear plants are in heavily populated areas. A rarely considered but potentially serious scenario is that of an avian flu epidemic, Marston said. Because symptoms don’t appear for 24 hours, an individual could infect an entire crew, leaving a dearth of personnel to run a plant. EPRI also talked the lessons learned from the Gulf Coast following Hurricanes Katrina and Rita, when high winds took down utilities’ walls and blew asbestos from their thermal insulation “everywhere.”

"For fuller text, visit http://web.mit.edu/newsite/2006/electricity.html."

— Deborah Halter
Nanoparticles combat cancer

Ultra-small particles loaded with medicine — and aimed with the precision of a rifle — are offering a promising new way to strike at cancer, according to researchers working at MIT and Brigham and Women’s Hospital.

In a paper published in the Monday April 16, online edition of the Proceedings of the National Academy of Sciences, the team reports a way to custom design nanoparticles so they home in on dangerous cancer cells, then enter the cells to deliver lethal doses of chemotherapy. Normal, healthy cells remain unaffected.

The team conducted experiments first on cells growing in laboratory dishes, and then on mice bearing human prostate tumors. The tumors shrank dramatically, and all of the treated mice survived the study; the untreated control animals did not.

“A single injection of our nanoparticles completely eradicated the tumors in five of the seven treated animals, and the remaining animals also had significant tumor reduction, compared to the controls,” said Dr. Omrid C. Farokhzad, an assistant professor at Brigham and Women’s Hospital and Harvard Medical School.

Farokhzad and MIT Institute Professor Robert Langer led the team of eight researchers. (Farokhzad was formerly a research fellow in Langer’s lab.)

The scientists said further testing is needed. Although all the parts and pieces of their new system are known to be safe, the system itself must yet be proven safe and effective in humans. This means thorough testing must be done in larger animals, and eventually in humans.

“We are most interested in developing a system that ends up in the clinic helping patients,” Farokhzad said. To make that happen, he added, “we brought in cancer specialists and urologists to collaborate with us. Further, he said, from an engineering perspective, “we wanted to develop a broadly applicable system, one that other investigators can alter for their own purposes.”

For example, Langer said, researchers “can do different imaging, or other things on the outside, of the nanoparticles. In fact, this technology could be applied to almost any disease” by re-engineering the nanoparticle’s properties. The nanoparticles work like a bus that can safely carry different passengers to different destinations.

In the study, Farokhzad, Langer and colleagues tailor-made tiny sponge-like nanoparticles laced with the drug docetaxel. The particles are specifically designed to dissolve in a cell’s internal fluids, releasing the anti-cancer drug either rapidly or slowly, depending on what is needed. These nanoparticles were purposefully made from materials that are familiar and approved for medical applications by the U.S. Food and Drug Administration. Thus all of the ingredients are known to be safe.

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Also, to make sure only the correct cells are hit, the nanoparticles are “decorated” on the outside with targeting molecules called aptamers, tiny chunks of genetic material. Like homing devices, the aptamers specifically recognize the surface molecules on cancer cells, while avoiding normal cells. In other words, the bus is driven to the correct depot.

In addition, the nanoparticles also display polyethylene glycol molecules, which keep them from being rapidly destroyed by macrophages, cells that guard against foreign substances entering the body.

The team chose nanoparticles as drug delivery vehicles because they are so small that living cells readily swallow them when they arrive at the cell’s surface. Langer said that particles larger than 200 nanometers are less likely to get through a cell’s membrane: A nanometer is one-billionth of a meter.

The Farokhzad-Langer team created nanoparticles that are about 150 nanometers in size: a thousand sitting side by side would equal the width of a human hair.

Additional authors of the new paper are Jingcheng Cheng, a formingsional fellow with Langer now at the University of Illinois; Benjamin A. Troty of Brigham and Women’s Hospital (BWH) and Harvard; Ines Sheriff, also at BWH and Harvard; Sangyong Jun, a former postdoctoral fellow with Langer now at the Gwanzu Institute of Science and Technology in South Korea; Philip W. Kantoff of the Dana Farber Cancer Institute; and Dr. Jerome P. Riemschneider. BWH and Harvard.

The research was supported, in part, by a grant from the National Cancer Institute (NCI) through the Harvard-MIT Center for Cancer Nanotechnology Excellence. The Harvard-MIT center is one of eight national Centers of Cancer Nanotechnology Excellence established recently by the NCI.

PLANET

Continued from Page 1

explosion blows away most of the star and any existing local planets, but that some

so-called “fallback disk,” material that has not escaped from the supernova explosion that occurred about 100,000 years ago.

“Our work provides the first direct evidence for such a scenario, because the debris disk we detected was likely formed from the fallback material,” Wang said.

Birth of strange planets

The research provides a missing link that would help explain a new, exotic type of planetary system that forms around pulsars.

Like most of the objects in space, the material that falls back toward the pulsar will keep rotating. If it rotates fast enough, it will end up forming a disk in orbit around the pulsar. That disk is unlikely anything in our solar system. Our sun, the planets in our solar system and most of the other stars and planets we know formed out of the same mix of materials: mostly hydrogen, some helium and tiny amounts of other elements such as oxygen and carbon.

However, a massive star is a nuclear furnace that converts hydrogen into all of the other elements. And the supernova explosion itself can provide more nuclear tricks. With the removal of hydrogen, instead of being mostly hydrogen, could be mostly iron, nickel or cobalt, and will likely contain all sorts of other interesting elements. What’s more, the disk is constantly bathed in the X-ray light and radiation, creating an extremely harsh environment.

In most solar systems, the star at the center collapses out of a cloud of gas. The remains of that cloud form a big disk around the star that eventually makes planets. “So, by analogy, the disk of debris that we could even see with our telescopes,” Kaplan said. “However, those planets would not have formed around them would have a very tough time.”

This work also help answer questions about how life on Earth formed. Some theories suggest that black holes form a sort of gravitational focus from the exploded star isn’t rotating fast enough, it could fall until it hits the pulsar. Then, what had become would become too massive and collapse quickly into a black hole, leaving no habitable area on them would help to decide whether this is possible.

NASAs Jet Propulsion Laboratory managed this work, funded by the National Aeronautics and Space Administration. This work is supported by NASA.

Chemist discovers secret behind nature’s medicines

Cathryn Delude
News Office Correspondent

MIT scientists have just learned another lesson from nature.

After years of wondering how organisms managed to create self-medications such as anti-fungal agents, chemists have discovered the simple secret.

Scientists already knew that a particular enzyme was able to coax a reaction out of stubborn chemical concoctions to generate a large family of medically valuable compounds called halogenated natural products. The question was, how do they do it?

Chemists would love to have that enzyme’s capability so they could efficiently reproduce, or slightly re-engineer, those products, which include antibiotics, anti-tumor agents, and fungicides.

Thanks to MIT chemistry Associate Professor Catherine L. Drennan’s recent crystallography sleuthing, the secret to the enzyme’s catalytic process has come to light, and it appears almost anti-climactic.

‘If an enzyme is a gun that fires to cause a reaction, then we wanted to know how it worked, it makes sense. But it’s not what we would have predicted.’

To make halogenated natural products, enzymes catalyze the transformation of a totally unreactive part of a molecule, in this case a methyl group. They break specific chemical bonds and then replace a hydrogen atom with a halide, one of the elements from the column of the periodic table containing chlorine, bromine and iodine. In the lab, that’s a very challenging task, but nature accomplishes it almost nonchalantly.

The trick involves using a turbo-charged proton containing iron. A clue as to how these enzymes operate emerged from a 2005 study by Christopher T. Walsh of Harvard Medical School, Drennan’s collaborator and co-author of the study published in the March 16 issue of Nature. Looking at the SyrB2 enzyme using X-ray crystallography to discover the physical structure of the protein, the X-rays scatter off the crystal, creating patterns that can be reconstructed as a three-dimensional model for study.

Normally, iron-containing enzymes have three amino acids that hold the iron in the active site. In this enzyme, however, one of the typical amino acids was substituted with a much shorter one.

That smaller substitute leaves more room in the active site — enough space for the halide, in this case a chloride ion, to casually slip inside and bind to the iron, without the grand theatrics chemists had anticipated. After the iron and the chloride bind, the protein closes down around the active site, effectively pulling the trigger on the gun.

“We were surprised,” Drennan said. “The change in activity required for an enzyme to be capable of catalyzing a halogenation reaction is so radical that people thought there must be a really elaborate scheme with the resources to turn their own creativity loose in their undergraduate classrooms. For example, some may design programs to attract more women and minorities to science. Others might turn large introductory science courses into engaging, hands-on learning experiences. The scientists whom we have selected are true pioneers — not only in their research, but in their creative approaches and dedication to teaching,” said Thomas R. Cech, HHMI president. “We are hopeful that their educational experiments will energize undergraduate science education throughout the nation.”

HHMI awarded $2 million to the first group of its professors in 2002. MIT Professor of Biology Graham Y. Walker received one of 19 HHMI awards.

The research was partially funded by the National Institutes of Health.

Drennan named million-dollar HHMI professor

Catherine L. Drennan, an associate professor in the Department of Chemistry, has been named a Howard Hughes Medical Institute Professor. The $1 million award honors top research scientists who are also great teachers.

Drennan is one of 20 new HHMI professors who, “through their teaching and mentoring, are striving to ignite the scientific spark in a new generation of students,” according to HHMI. HHMI does not tell the professors what to do or how to approach science education. Rather, it provides them with the resources to turn their own creativity loose in their undergraduate classrooms.

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Show and tell

John Hutchinski, with his father Pete behind him, shows how a robot submarine works.

John Hutchinski, with his father Pete behind him, shows how a robot submarine works.

Some crystallography sleuthing by Associate Professor Catherine L. Drennan of chemistry has uncovered the secret behind some naturally produced medicinal compounds. Drennan was also recently named a Howard Hughes Medical Institute Professor.

Leah C. Blasik, who was first author of the study, crystallized SyrB2 and then used X-ray crystallography to discover the physical structure of the protein. The X-rays scatter off the crystal, creating patterns that can be reconstructed as a three-dimensional model for study.

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Physical scientists get to heart of antimatter

The rapid matter-antimatter oscillations, 3 trillion times per second, gives a glimpse of the development of the early universe and might help us understand why there is so little antimatter in it right now,” Paus said.

The researchers’ goals are to discover the identity and properties of the particles that make up the universe and to understand the forces and interactions between those particles. Over the past 20 years, more experiments world-wide have been part of a program to make high-precision measurements of the behavior of matter and antimatter.

Scientists hope that by assembling a large number of precise measurements involving the exotic behavior of these particles, they can begin to learn how these particles exist, how they interact with one another and what role they played in the development of the early universe.

Although none of these particles exists in nature today, they were present in great abundance in the early universe. Scientists can only study these particles now at large particle accelerators.

Within the high-energy physics community, the new measurement will immediately be interpreted within different theoretical models. The fact that it confirms the 25-year-old existing theory, the Standard Model of Particle Physics, “means that nature has not yet revealed its secret for why matter and antimatter dominate the universe,” Paus said, “although this result will refute some theories based on even faster oscillations.”

“As an experimentalist, the pleasure of ruling out new theories is second only to ruling out the existing one,” Paus said. “This measurement is not the end of the story. It opens new venues to pursue the quest for nature’s best-kept secrets.”

CDF is supported by the DOE, the NSF and international funding agencies.
Wellness Week message: Sleep and eat
Sasha Brown
News Office

Wellness Week kicked off the morning of April 10 with a host of events focusing on mental health, fitness and nutrition that will end Sunday, just in time for the Boston Marathon on April 11.

“It seemed like the perfect time to focus on this,” said Yao-Chung King, chair of the Undergraduate Association’s Committee on Student Life, the organizing group. “It is just after spring break and right before everything gets really crazy.”

Although there have been similar events in the past, this is the first one to be almost entirely organized and run by students, said King. The Klamath Club and other committee members raised more than $15,000 from sponsors on campus and off.

On Monday, an early morning yoga class on Kresge Oval was immediately followed by a podwalk and sit-down market. Later, a fitness fair in the Zeisger Center highlighted MIT’s many club and varsity sports, as well as physical education classes available for students.

“The best thing we all support one another,” said King. Students can go from a cooking class to a fitness activity and then to a very relaxing activity like the four-hour “Nap Zone,” which invited students to nap on beds in the Student Center. Some events focus on body image and self-esteem, such as Tuesday night’s “Stand Up Stand Out” event, sponsored by the Social Concerns-Body Image and Eating Disorders Action Team.

On Thursday, a chef will give a healthy cooking demonstration in front of the Student Center, creating meals with food that can be purchased on campus. “We wanted to make this as accessible as possible,” said King.

A mini-triathlon, the “Iron Nerd,” will pit competitors against one another as they swim four laps, wheel around “dhow row” (a row of 3,000 books), and ride roller skates (“creativity is encouraged,” King said), then finish with a mile-long run around campus. The Iron Nerd starts Saturday at 11 a.m. For a complete list of events, see the web site at http://web.mit.edu/wgww/.

Wellness Week started off Monday, April 10, with push-ups on Kresge Oval featuring senior Zack Eisenstat, junior Chris Cabral and freshman Mark Norsworthy.

A graduate student in mechanical engineering, and H. Harry Asada, the Ford Professor of Mechanical Engineering, presented a paper on simplifying routing among connectors and integrating systems that use conductive fabrics, which are made of nylon and polyester with a silver, nickel or aluminum coating.


Sasha Brown
News Office

STUDENT EMPLOYMENT

Call for applications for work-study jobs: May 16

Course: High school students

This is an opportunity for high school students to work at MIT while at home. Summer employment will be available on Monday, May 15, from 5:00 to 5:30 p.m., in Room 3-133. Please send resumes by May 3 to: info@web.mit.edu.

Conference explores work that crosses disciplines
Sarah H. Wright
News Office

Graduate students in architecture, engineering and political science will invite cross-disciplinary discussions of cutting-edge research projects at a two-day conference to be held on Friday, April 14, and Saturday, April 15.

The conference, titled “Research in progress,” is hosted by the Department of Architecture and organized by graduate students Jennifer Ferger, in history, theory and criticism of architecture, and Michael Baker, in electrical engineering and computer science (EECS). The event is free and open to the public.

“Often graduate study requires that we focus on research in great depth. Research in progress is an opportunity for me to contribute to a forum where cultural, political or ethical dimensions of any research can be explored,” said Baker.

“Approaching material from different points of view, as in this type of collabora- tion, can be extremely beneficial,” Ferger said.

Wang-Ho Chang, head of architecture, will open “research in progress” on Friday evening in the Advanced Visualization Theater, Room 3-433.

Discussion sessions on Saturday will be held in Room 10-105. There will include “Scientists and Diplomats (and the Archi- tects Who Love Them)” and “Second Nature: A Critical Look at the Built Environment.”

Most presenters are already involved in interdisciplinary work and are excited about the conference to invite even wider discus- sion.

As Lucia Alihs, HTC doctoral student, noted, “Interdisciplinary is a very healthy habit. It forces a certain rigor; you have to be more open-minded and able to be doubly sure of every assertion if you are to have a more critical outside your discipline.”

Alihs will present her research on the temporary U.N. headquarters built in New York in 1953 and 1963.

Nick Buchanan, doctoral student in sci- ence, technology and society, will present part of his dissertation project, a study of the costly, elaborate failure of the federal government to “civilize” the Navajo and Hopi indians and force them to abandon hunting for farming. (The Klamath reservation was established in southern Oregon in 1841.)

Beaudy Rock, master’s candidate in civil and environmental engineering, studies collaborative decision-making as it applies to contemporary water resource conflicts in the American West.

“Skip across disciplines every day in my research,” said Rock. “I’m working to make new links to new fields and practitioners at all the time,” he said.

On a Hill staff will prepare curriculum for tutors and be available to help tutors every step of the way. Contact Michael Lecron at 617-253-8988 x2111 or mlecron@mit.edu.

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MISCELLANEOUS
$4.25 million donated to support humanities

Sarah H. Wright
News Office

The School of Humanities, Arts and Social Sciences has received a $4.25 million gift from an anonymous donor and spouse who wish to remain anonymous.

The gift will establish a $25 million endowed fund for a Contemporary French Studies Fund and will support the Hyperstudio and Comparative Media Studies Program through a $1.25 million in endowment gifts over the next five years.

In announcing the gift, Philip S. Khoury, the Kenan Sahin Dean of Humanities, Arts and Social Sciences, said, “This generous gift will have an enormous impact on the humanities at MIT. It will support the continuing creative initiatives of our French faculty and provide critical core funding for our innovative Hyperstudio and Comparative Media Studies Program.”

The new Contemporary French Studies Fund will make it possible for French program faculty to develop new courses and ambitious programming, host visiting professors and writers, organize conferences and foster student cultural exchanges. It will also support the continuing development of such existing projects as Cultura, a web-based tool designed to build cross-cultural understanding between American and French students.

The gifts to support the Hyperstudio and Comparative Media Studies Program will help humanities faculty and students develop cross-disciplinary curriculum and research projects in which they use and study media technologies.

The gift, and administered by the foreign languages and literatures section, the Hyperstudio houses a wide range of interactive media content and projects developed for the classroom across disciplines that include foreign languages and literatures, literature, music, comparative media studies and history. This rich content is fueled by a technology that facilitates the collaborative sharing of media among faculty and students.

Comparative media studies is a multi-disciplinary program at MIT examining media technologies and their cultural, social, aesthetic, political, ethical, legal, and economic implications. The program offers a master’s degree and graduate certificate major (now the largest humanities major at MIT). Its faculty and students are engaged in a range of research projects, partnering with foundations and industry in areas that include media literacy, the development of education technologies and media convergence.

Architect Holl builds on themes

Robbin H. Ray
News Office Correspondent

Award-winning architect Stephen Holl shared some of the themes of the running through his building designs, including “porosity,” a concept given concrete illustration in Simon Siegel’s film. Holl builds a campus lens.

His design for the residence hall, sometimes familiarly called the “Space Waffle,” was inspired by the water treatment lagoon that is at the heart of the campus. Holl said, “It is a familiar sight to many students and faculty who stroll through the lagoon.”

Holl organized his presentation in Room 10-250 around five themes—fragments, porosity, insertions, precincts and fusion—that have informed his work over the past two decades. His projects display diversity—museums, churches, housing complexes and commercial buildings—and many are built using environmentally sustainable, environmentally sensitive architecture.

His most ambitious porous project is a massive housing development under construction in Beijing, which seeks to break up the grim monotony of the high-rise apartment complexes. The eight towers of Holl’s project vary in height and are connected by sweeping walkways. Their lower levels provide space for the necessities of urban Chinese mindsets, such as shops and a cinema. It is the largest geothermal residential project in history.

Under the theme he calls “fragments,” Holl showed a number of projects that attempt to rein in the ragged sprawl of modern urban development. He designed low-cost, densely packed housing complexes in Phoenix, Ariz., and Nanjing, China, that bracket the natural space and use gray-water recycling and garden areas to create resources.

Finally, Holl discussed “fusion,” a notion best exemplified by the wastewater treatment plant he designed for New Haven, Conn., that has turned out to be a prized setting for weddings.

Artist explores human-robot interaction

Lauren Maunder
Office of the Arts

Alumna Pia Lindman, who has received acclaim for her performance and video artwork exploring human gesture, has a new solo show in the MIT Museum’s Compton Gallery. She will become a human imitating machines that imitate human gestures.

“Pia Lindman: Embodiments,” opens on Tuesday, April 18, with a reception in the gallery from 5:30 to 7:30 p.m. The exhibition includes drawings, videos and video documentation of her recent studies of humans interacting with robots.

Lindman will perform “The MIT Project,” a series of embodiments of the interactions between human beings and robots built at the Humanoid Robotics Group at Computer Science and Artificial Intelligence Laboratory (CSAIL), at approximately 6 p.m. on April 18. The MIT piece was conceived during her 2005-2006 fellowship at MIT’s Center for Advanced Visual Studies (CAVS). She is artist-in-residence at CSAIL.

Lindman’s work highlights the intricate possibilities of human expression through gesture. It also probes the gulf between humans and machines while witnessing what happens when the two merge.

When she began working at CSAIL last summer, Lindman observed that there is always “something emotional in the relationship” between a researcher and his or her subject — even if that subject is a robot.

Lindman’s plans include further exploration of the border between the human and non-human: She hopes to work with biomechanics, where mechanical limbs provide biological sensory input to the body to which they are connected.

Lindman earned her master of science in visual studies from MIT in 1999 as a Fulbright Scholar and served last year as a lecturer in the Visual Arts Program.

“For more information, call x3-4444.

Religious integration possible for Europe’s Muslims, Grand Mufti says in talk

Sasha Brown
News Office

Assimilation is possible for the roughly 30 million or more Muslims currently living in Europe, according to Mustafa Ceric, Grand Mufti of the Republic of Bosnia and Herzegovina, the highest official of religious law in that country.

“Europe has never been a continent of one faith,” Ceric told the audience gathered in Room 54-100 for his April 4 talk titled, “European Muslim Identity in the New Millennium.” The responsibility for assimilation lies with both the European Muslim minority and the European majority, he said.

Ceric proposed that a third option be added to the traditional Islamic concept that one either lives in an Islamic country or in a state of war fighting to keep the values of Islam alive: “Europe is neither a house of Islam or war. Europe is the house of contrast, peace and reconciliation,” he said.

“An understanding of Europe is very important for Muslims,” said Ceric, who said Muslims should try to embrace this third option, and that many Europeans need to eliminate their prejudice against Islam.

“I worry about the future of Muslims in Europe especially after recent events in Denmark,” said Ceric, referring to the editorial cartoons depicting the Prophet Mohammad in a negative light that appeared in a Danish newspaper and set off a series of violent protests around the world. The cartoons were “mean to hurt,” Ceric said. They “left a bitter feeling.”

Condemning the recent terrorist attacks against the United States, England and Spain, Ceric said that “Muslims around the world have been shocked (by the attacks).” He encouraged Muslims in Europe to be proactive.

“The East believes Islam is the answer and the West believes Islam is the problem. . . both are using and misusing Islam,” Ceric said. He encouraged Muslims to live by the principle that “Islam is about the West and the East.”

“I am very optimistic,” Ceric said. “I believe in the new generation of Muslims.”

His visit was sponsored by the Center for International Studies, the Muslim Students Association and the Technology and Culture Forum at MIT.
### Big advance for tiny particles

MIT chemical engineers have devised an elegant new method for creating complex polymeric microparticles that could have applications in a variety of fields, from drug delivery in medicine to the creation of building blocks for the photonic properties of the microparticles, which range in size from about 1 millionth of a meter to a millimeter.

“We have precise control over shape and an ability to create patterned chemical regions, that is rather unprecedented,” said Assistant Professor Patrick Doyle of chemical engineering, one of the authors of a report appearing in the online edition of Nature Materials on April 9.

Doyle says he hopes other researchers will adopt his team’s new technique of continuous flow lithography (CFL), which allows for faster, easier production of microparticles of diverse shape, size and chemical composition.

CFL builds on the well-known technique of photolithography, but its novelty lies in the fact that it is performed in a laminar (not turbulent) flowing stream as opposed to the traditionally used stationary film. Wherever pulses of ultraviolet light strike the flowing stream of small building blocks, or oligomers, a reaction is set off that forms a solid polymeric particle in a process known as photopolymerization.

The method makes use of microfluidics—tiny fluid-filled channels with cross-sections typically smaller than a strand of hair. Until now, microfluidic methods have been limited to producing spherical discs or cylinders.

However, with CFL, the particles can be configured into just about any projected 2D shape the researchers want by using a transparency mask to define the shape of a beam of ultraviolet light and focusing it with a microscope. As liquid flows through a microfluidic device, where the synthesis occurs, the shape is repeatedly imprinted onto the oligomer stream, at a rate of about 100,000 particles per hour with the current simple design.

From an engineering point of view, converting a batch process (photolithography) to a continuous process may have significant advantages when we consider scaling up the technique,” said graduate student Lindy Blackburn, one of the authors.

Lead author Daniel Pregibon, one of the authors, said he is interested in creating diagnostic tests, such as testing for various diseases.

The research was supported by a grant from the National Science Foundation.

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### Editor’s Choice

#### “KEEPING THE PEACE IN BOSNIA”

**Apr. 12**

Talk by Alan Kuperman on “Power Sharing or Partition? History’s Lessons for Keeping the Peace in Bosnia.”

Room E38-615

 Noon

#### “PALESTINE/ISRAEL”

**Apr. 13**

Talk by Ali Abunimah on “Palestine/Israel: Peace or Apartheid?”

Room 10-250

7 p.m.

#### “BLOGGER’S WAR”

**Apr. 15**

Movie screening and discussion of how Iranian expatriates fight for freedom of speech.

Room 4-237

5:30 p.m.

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### Personal Space

Six photographs by MIT students are on view through Saturday, May 6, at the Photographic Resource Center’s 2006 Annual Students’ Exhibition in Boston. This photograph is by Alison Hammer, a graduate student in architecture. For more information, visit www.bu.edu/prc/.

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**Go Online!** For complete events listings, see the MIT Events Calendar at: http://events.mit.edu.