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TechTalk
SERVING THE MIT COMMUNITY

Marc A. Kastner

Kastner of physics is new dean of science

Marc A. Kastner, the Donner Professor of Science and current head of the Department of Physics, will succeed Class of 1942 Professor of Chemistry Robert J. Silbey as the next dean of the School of Science. Kastner has served as head of the Department of Physics since 1998; he will assume his new leadership role July 1.

Provost Rafael L. Reif announced Kastner's appointment to the MIT community today. In making the announcement, Reif noted that, under Kastner's leadership, the department of physics had "enhanced its reputation as one of the world's great centers of excellence in its field."

In his letter, Reif cited the success of Kastner's initiatives in the department, including "bringing in exceptional new faculty, introducing a new flexible degree option and increasing the number of its majors, and moving ahead with the construction and renovations comprising the new Green Center for Physics, which will be completed this spring."

Reif also noted the "critical role" played by Kastner's "collegial approach and emphasis on thoughtful strategic planning."

The School of Science, Reif wrote, has a "well-deserved reputation for leadership in teach-

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New drug may dissolve tumors' defense against chemotherapy

Anne Trafton
News Office

MIT researchers have identified a critical defense mechanism that tumor cells employ to survive the toxic effects of chemotherapy—knowledge that could very soon lead to more-effective cancer treatments.

The findings, reported as the cover story in the Feb. 13 issue of Cancer Cell, show that after chemotherapy, many tumors resort to using a signaling pathway normally associated with the inflammatory response in order to survive.

Drugs that knock out this inflammatory defense mechanism would render tumors vastly more susceptible to chemotherapy, according to Michael Yaffe, MIT associate professor of biology and biological engineering, and leader of the research team. One such drug is already in the pipeline.

"In the clinic, we could use lower doses of chemotherapy and get a more profound reduction of the tumor with fewer side effects in patients by targeting this pathway," said Yaffe, who is affiliated with MIT's Cancer for Cancer Research, the Broad Institute of MIT and Harvard, and Beth Israel Deaconess Medical Center.

Knocking out the inflammatory pathway should be an effective tactic against most tumors—namely, tumors that lack p53, a protein known to protect normal cells from becoming cancerous. (Cells with p53 don't rely on the pathway for

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PHOTO / **DONNA COVENEY**

Getting ready to react

MIT engineers are working on upgrades to the Alcator C-Mod reactor, where scientists study fusion reactions. The upgrades will help researchers towards their goal of making fusion a viable energy source. See story on page 5.

Nanoengineered concrete could cut CO_2 emissions

Denise Brehm
Civil and Environmental Engineering

While government leaders argue about the practicality of reducing world emissions of carbon dioxide, scientists and engineers are seeking ways to make it happen.

One group of engineers at MIT decided to focus its work on the nanostructure of concrete, the world's most widely used material. The production of cement, the primary component of concrete, accounts for 5 to 10 percent of the world's total carbon dioxide emissions; the process is an important contributor to global warming.

In the January issue of the Journal of the Mechanics and Physics of Solids, the team reports that the source of concrete's strength and durability lies in the organization of its nanoparticles. The discovery could one day lead to a major reduction in carbon dioxide emissions during manufacturing.

"If everything depends on the organizational structure of the nanoparticles that make up concrete, rather than on the material itself, we can conceivably replace it with a material that has concrete's other characteristics—strength, durability, mass availability and low cost—but does not release so much CO_2 into the atmosphere during manufacture," said Franz-Josef Ulm, the Esther and Harold E. Edgerton Professor of Civil and Environmental Engineering.

The work also shows that the study of very common materials at the nano scale has great potential for improving materials in ways we might not have conceived. Ulm

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Experts foresee sustainable ethanol production

Anne Trafton
News Office

As the search for alternative fuel sources intensifies, more and more attention has been focused on ethanol—a fuel many see as desirable because it burns cleanly and can be produced from plants.

In recent days, two MIT chemical engineering professors have weighed in on ethanol's potential—Professor Gregory Stephanopoulos, in a Feb. 9 article for Science, and Assistant Professor Kristala Jones Prather, who testified during a Senate hearing on biofuels on Feb. 1.

Both professors expressed optimism that biofuels can become a significant part of the U.S. energy supply but said that much more research must be done before ethanol can reach its full potential.

"Biofuels represent a grand challenge in technology," Prather told the Sen-

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Economist critiques housing price predictions

Stephanie Schorow
News Office Correspondent

To the saying, "There are lies, damn lies and statistics," MIT economist William C. Wheaton might add another line: "and housing model forecasts."

In a packed IAP seminar Jan. 30 on "How Far Will the Housing Bubble Burst?" Wheaton, who holds a joint appointment in the Departments of Economics and Urban Studies and Planning, showed how forecasting models based on historic data may not match the complicated reality of today's housing market.

Wheaton's own econometric models of home pricing, based on data through 1998, were used to forecast housing prices from 1998 to 2005 in major American cities. The models predicted that housing prices would undergo a correction and fall as job growth and income stalled, particu-

See **HOUSING**
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Economics of climate change reviewed

Ruth Walker
News Office Correspondent

Sir Nicholas Stern's report on the economics of climate change was a political document rather than a scientific one. It's based on some significantly flawed scientific premises—to a degree likely to undercut the report's credibility, in some circles at least.

But the report was significant for being produced at all—as the first attempt by a major national government to identify climate change "as an urgent and serious issue," as Paul L. Joskow, professor of economics, put it, and to quantify its costs.

These were some of the conclusions of an IAP presentation, "The Economic Impacts of Climate Change: a Discussion of the Stern Review," given Feb. 1, with Robert Solow, professor of economics emeritus, moderating.

The Stern report, commissioned by British Chancellor of the Exchequer Gordon Brown, and produced by a former chief economist of the World Bank, was released Oct. 30, 2006. It captured headlines with two critical numbers: 1 percent and 20 percent.

Global warming, if left unchecked, could lead to the permanent loss of up to 20 percent of gross world product annually well out into the future, Stern warned. On the other hand, the cost of mitigating action to avoid the worst effects of climate change could be confined to only 1 percent of global GDP, he suggested.

The Stern report was hailed as a "wake-up call" to the world by Prime Minister Tony Blair and Hans Verolme of the World Wildlife Fund, among others.

The MIT review of Stern came on the eve of the release, in Paris, of another, bleaker assessment of global warming: the latest report of the Intergovernmental Panel on Climate Change (IPCC). This document was described as "a screaming siren" by Stephanie Tunmore of Greenpeace.

"This isn't a group that doesn't care about global warming," Henry Jacoby, professor in the Sloan School and the Joint Program on the Science and Policy of Global Change, told the standing-room-only crowd in E51-315. He was referring to his fellow presenters' concern that the report's weaknesses would give ammunition to those who argue against the need for action.

Robert Solow

Stephen Ansolabehere

Specifically, he challenged Stern's "1 percent" estimate of the cost of remedial action and assumptions about falling energy costs.

Ronald Prinn, professor of earth, atmospheric and planetary sciences, faulted Stern for failing to consider varying rates of change or to distinguish among greenhouse gases with differing lifetimes (methane dissipates relatively quickly; perfluorocarbons last tens of thousands of years).

But the Stern report offers an approach, which includes physical and biological as well as economic and social components, that has been MIT's approach to the study of climate change. This is "unusual" in an international document and "has not yet been achieved by the IPCC," Prinn noted.

Addressing the question of public attitudes on global warming, Stephen Ansolabehere, professor of political science, took issue with figures cited in the Stern report showing that Americans express the lowest level of concern about climate change of any group polled.

The only meaningful measure of public concern about a given issue, Ansolabehere said, is expressed willingness to pay to solve it. He said his own research suggested that Americans are like citizens elsewhere: Very few are unconcerned about global warming, and they are willing to pay for mitigation—but not very much.

On the other hand, global warming has moved significantly up the list of environmental issues the public is concerned about—"although that probably has more to do with pictures of polar bears on ice and those penguin movies than with the Stern report," he added. Americans who called global warming the most important environmental issue rose from 11 percent in 2003 to 35 percent in 2006.

President Bush's new view that climate change is an issue "is an enormous, colossal change," Ansolabehere said.

Seventeen will receive Excellence Awards

Anne Trafton
News Office

There are undoubtedly many unsung heroes at MIT, but one who stands out will receive this year's Excellence Award in the Unsung Hero category: Gary Pascucci, a driver at MIT Lincoln Laboratory.

Pascucci not only knows his way around and delivers Lincoln Lab guests and employees to their destinations on time, he is courteous, easy-going and endlessly reliable, according to Lincoln Lab employees who nominated him for the award.

The annual Excellence Awards, part of MIT's Rewards and Recognition program, acknowledge innovation, leadership, collaboration, dedication, outreach, inclusiveness, service and results. The program is designed to recognize individuals and teams for their exceptional contributions to their office, department or school—or to the Institute as a whole.

Lincoln employees who nominated Pascucci said that he is unfailingly cheerful, dedicated and professional, no matter what the circumstances.

"In his position as a transportation driver he must contend with elements beyond his control on a daily basis, such as traffic jams, road construction, weather, mechanical breakdowns and, perhaps most importantly, the Massachusetts driver," wrote Bill Ustaszewski, an administrative group leader at Lincoln Lab.

Pascucci is always willing to do whatever needs to be done, changing his personal plans to accommodate unexpected emergencies and making sure that all visitors to Lincoln Laboratory have an enjoyable and safe experience, according to employees who nominated him. They also describe him as a skilled driver who is both dependable and pleasant.

"When it comes to assisting others and making sure that the job gets done, the word 'no' is not in Gary's vocabulary," wrote Ustaszewski.

"He is a top level employee of Lincoln Laboratory," wrote Barbara Raymond and Liz Whalen of the Lincoln director's office. "(We are) proud that VIPs and others first encounter an exemplary employee of whom we can be proud."

Janet Fischer, special assistant in the Office of the Provost, will also be honored with an Excellence Award, in the Fostering Community category. Fischer's work centers on building community among postdocs, grad students and prospective grad students, according to the MIT employees who nominated her.

Several nominators said Fischer's work has had a major impact on increasing MIT's diversity when it comes to underrepresented minority students.

Fischer plans and runs the annual Converge weekend, which draws prospective minority students, and also works on the MIT Summer Research Program, which offers minority students from other colleges the chance to do research at MIT during the summer.

Fischer's colleague, Joan O'Brien, who also works in the provost's office, nominated Fischer for the award to make sure "Janet's tenacity and hard work on Converge" would be acknowledged when MIT's minority student statistics increase. "This is why I would like for her to be acknowledged by the MIT community now," O'Brien wrote.

Assistant Dean for Graduate Students Christopher Jones, who works with Fischer on Converge and also nominated her for an Excellence Award, said the program has been highly successful in changing attitudes within MIT and helping prospective students feel at home at the Institute.

Fischer was also instrumental in establishing the MIT Postdoctoral Scholars Advisory Council, which was launched four years ago to help build a stronger community and support network among postdoctoral researchers.

"Postdocs across the Institute now feel they have more of a community and a place to turn for help largely because of Janet's efforts and dedication," wrote Marilyn Smith, special projects director in the Office of the Vice President for Research.

The Excellence Awards ceremony will be held Feb. 28 in Kresge Auditorium, with opening remarks from President Susan Hockfield and a keynote address from Associate Provost Philip S. Khoury. Refreshments will be served beginning at 11:30 a.m., and the awards presentation will start at noon, followed by a reception at 1 p.m.

For a complete list of the Excellence Awards recipients, see page 3.

No Tech Talk next week

In honor of Presidents' Day, there will be no Tech Talk on Wednesday, Feb. 21. The next Tech Talk will be published on Feb. 28. For ongoing MIT news updates, please go to the News Office web site, web.mit.edu/newsoffice/.

MIT reorganizes academic computing services

Academic computing services at MIT have recently been realigned to better support educational innovation and improve responsiveness to faculty and students. Over the past several years, many educational technology projects, organizations and services have evolved and matured. These include initiatives such as iCampus, as well as services such as videoconferencing and the Stellar course management system. The organizational changes will address the sustainability of these projects and services, while providing a collaborative environment for exploring new options.

Based on recommendations of a committee appointed by the provost, the Office of the Dean for Undergraduate Education (DUE) now leads and promotes educational technology innovation at MIT. The DUE has formed an Office of Educational Innovation and Technology (OEIT), which is staffed primarily by the educational consulting and software development groups formerly in the Academic Computing group in Information Services & Technology. This office will work closely with the Teaching and Learning Lab and the Office for Faculty Support. Academic Media Production Services (AMPS), with the exception of Stellar, is now part of the MIT Libraries. IS&T will continue to maintain academic computing clusters, including Athena clusters. The Stellar development team has moved from AMPS to IS&T's infrastructure software development and architecture group. See story on OEIT, page 6.

The Office of the DUE, the Libraries and IS&T are committed to working together to ensure responsive and seamless academic computing services. Toward this end, the Academic Computing Coordinating group (ACCORD) has been established, initially with representatives from OEIT, the Libraries and IS&T. ACCORD will work closely with faculty and staff to ensure that the combined academic computing service portfolio offered by the DUE, the Libraries and IS&T supports their perspectives on academic computing at MIT. A key goal of ACCORD is to move innovation from the lab into the classroom more effectively, while allowing faculty and students to take a more active role in designing and experimenting with technology for teaching and learning. ACCORD welcomes input from the community. Anyone with questions about academic computing services, can reach the group at accord@mit.edu.

MIT's Council on Educational Technology (MITCET) will develop a review process for setting priorities in educational technology; this process will be administered by the dean for undergraduate education. MITCET brings focus and commitment to MIT's educational technology initiatives by providing strategic guidance to program and infrastructure initiatives designed to enhance the quality of an MIT education; coordinating Institute-wide educational experiments and programs; and assessing the effectiveness of educational technology initiatives.

Additionally, the dean for undergraduate education, with the assistance of the vice president for information services and technology, will prepare an annual report of educational technology spending. This report will be presented to MITCET and the Information Technology Strategic Planning and Resources Coordinating Council (IT-SPARCC) for their subsequent recommendation to the provost and executive vice president. IT-SPARCC functions as the strategic coordinating body for information technology at MIT.

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Chemical engineer: Geothermal is undervalued U.S. energy source

Deborah Halber
News Office Correspondent

Icelanders, who get most of their heating, hot water and a good portion of their electricity from geothermal sources, are well aware that Reykjavik, which means "Smoky Bay," is named for the steam from the local hot springs. In the United States, especially in the nonvolcanic northeast, we don't tend to think about geothermal energy.

Jefferson Tester, the H.P. Meissner Professor of Chemical Engineering, thinks that should change. "Unless you're from Iceland, you don't make the connection to thinking about geothermal. We're trying to increase awareness that this technology may not be as far away as people think," he said at an MIT Museum Soap Box event on Feb. 7.

Tester, who headed an MIT-led study of the potential for ramping up geothermal energy within the United States, spoke on "Geothermal—An Undervalued Primary U.S. Energy Source" at the Soap Box, one of a series of salon-style, early-evening conversations on ideas and issues in science and engineering.

Tester said that although geothermal energy is produced commercially today, existing U.S. plants have focused on the high-grade geothermal systems primarily located in isolated regions of the West. Using enhanced geothermal system (EGS) technology would greatly increase the fraction of the U.S. geothermal resource that could be recovered commercially, he said.

The United States, generating 300 megawatts, is already the biggest producer of geothermal. "If geothermal is going to be anything more than a minor curiosity, it has to reach at least the level of hydro and nuclear power, or 100,000 megawatts out of 1 million—one-tenth of total capacity," he said. Geothermal would be a particularly attractive way to replace the high proportion of electricity that comes from coal-fired plants, which contribute to global warming.

The technology to achieve EGS borrows heavily from oil and gas drilling that already exists. "We're talking about instead of mining minerals out of the ground, we're mining heat," he said. Although the $600 to $800 million price tag seems hefty, Tester pointed out that it is less than the cost of "one big clean coal plant," which would cost roughly $1 billion.

Tester was part of the 18-member panel that prepared the 400-plus page study, "The Future of Geothermal Energy," for the U.S. Department of Energy.

The study found that mining the huge amounts of heat that reside as stored thermal energy in the Earth's hard rock crust could supply a substantial portion of the electricity the United States will need in the future, probably at competitive prices and with minimal environmental impact.

The process involves drilling to as deep as 30,000 feet, pumping water under pressure into fractures to break apart underground rock formations and freeing up reservoirs. Seismic activity is a risk, he said. "The big challenge is to show you can do it not only in California, but also in the Midwest and ultimately on the East Coast, where you have to go deeper." Among geothermal's advantages are its below-ground, out-of-sight nature, making it easier to site, and its high capacity. Unlike solar and wind, which only work when the sun shines and the wind blows, geothermal runs all the time.

"We're hoping people won't walk away from this thinking it is too far out," Tester said. "I want to make sure we're looking at all options."

Victor Zue will direct CSAIL

Victor Zue, co-director of MIT's Computer Science and Artificial Intelligence Laboratory (CSAIL), will become sole director of the lab, effective July 1.

Dean of Engineering Thomas Magnanti announced today that Zue, the Delta Electronics Professor of Electrical Engineering, will share the director position with Rodney Brooks from April 1 until June 30, when Brooks will return to regular faculty status.

Victor Zue

"While CSAIL continues to be among the crown jewels of the School (of Engineering) and the Institute, as Victor notes, there is always room for improvement," Magnanti wrote in his e-mail announcement. "He and I agree that almost four years after the merger and three years after moving into Stata, this seems an opportune time for reflection and assessment."

Zue will begin meeting with CSAIL principal investigators to talk about a process for self-reassessment and will recruit a new faculty leadership team, according to Magnanti. He will also convene a faculty committee to examine the current state of the lab and provide input on its strategic directions.

Zue's primary research interest is the development of spoken language interfaces to make human-computer interactions easier and more natural. Prior to 2001, he headed the Spoken Language Systems Group, which has pioneered the development of systems that enable a user to interact with computers using multiple spoken languages.

Outside of MIT, Zue has served on many planning, advisory and review committees for the U.S. Department of Defense, the National Science Foundation and the National Academy of Science and Engineering. In 2004, he was inducted into the National Academy of Engineering.

Zue, former director of the Laboratory for Computer Science, has served as co-director of CSAIL since it was formed in a merger with the Artificial Intelligence Laboratory in 2003. Brooks, former director of the IA Lab, has served as CSAIL's director since the merger.

Magnanti thanked Brooks for his "outstanding service as CSAIL director."

"The last few years have been an exciting and challenging time for CSAIL, with the merger of LCS and the AI Lab, the growth of the computer science faculty, the move into the Stata Center, and significant changes in sources of support for computer science research," he wrote. "Rod and Victor have done a marvelous job in navigating these waters. It has been a privilege to work closely with Rod and I very much look forward to collaborating with Victor and the new CSAIL faculty leadership team in the months ahead."

KASTNER

Continued from Page 1

ing and research. I know that Professor Kastner, in his new role, will build on the accomplishments of Bob Silbey's seven years as dean to ensure the school's continued preeminence."

Kastner said of his appointment as dean, "It is an enormous honor to be entrusted by the provost and the president with the leadership of the best school of science in the world. Dean Bob Silbey has left the school in excellent shape, with many new faculty members and several new or renovated buildings. I know that each of the departments, centers, labs and institutes in the school aspires to become even stronger, and I want to help in any way I can."

Before his appointment as head of the Department of Physics, Kastner served for five years as director of the interdisciplinary Center for Materials Science and Engineering. From 1989 to 1997, he chaired the MIT Campus-Lincoln Laboratory Interaction Committee.

Kastner was educated at the University of Chicago, where he received his S.B. in chemistry and his Ph.D. in physics, and he joined the MIT faculty in 1973 after a research fellowship at Harvard University. His early research focused on amorphous semiconductors, materials which are useful for solar cells. He has also studied the physics of high-temperature superconductivity. In 1990 his group fabricated the first semiconductor single-electron transistor, and the group continues to use these devices to study the quantum mechanical behavior of electrons confined to nanometer dimensions. He has been the recipient of the David Adler Lectureship Award and the Oliver E. Buckley Prize, both awarded by the American Physical Society.

Reif also expressed his gratitude for the "excellent" work of the committee that advised him on the search, which was chaired by John D. Joannopoulos, the Francis Wright Davis Professor of Physics, and also included Professors Tania A. Baker (biology), Moungi G. Bawendi (chemistry), Jesus del Alamo (electrical engineering and computer science), Ann M. Graybiel (brain and cognitive sciences), Paula T. Hammond (chemical engineering), Paola Malanotte-Rizzoli (earth, atmospheric and planetary sciences) and Gigliola Staffilani (mathematics).

And the Excellence Award winners are…

Fostering Community: Janet E. Fischer, special assistant, Office of the Provost, and Helen Rose, associate director, Office of Development Research and Systems, Resource Development.

Creating Connections: Edward Moriarty, technical instructor, Edgerton Center; Christopher Resto, administrative director, Undergraduate Practice Opportunities Program (UPOP), School of Engineering; Daniel A. Trujillo, associate dean, Community Development and Substance Abuse Program, Dean for Student Life.

Bringing Out the Best: Jim Harrington, facilities manager, School of Architecture & Planning; Ronald Hasseltine, assistant dean, School of Science.

Serving the Client: Joseph F. Connolly, assistant director for administration, Research Laboratory of Electronics; Anne Deveau, administrative assistant, History, Theory and Criticism of Architecture and Art, School of Architecture; Anne C. Maloney, senior stock clerk, Laboratory for Nuclear Science, School of Science; Cynthia McLain, associate staff, Group 62, Information Systems Technology Group, Lincoln Laboratory; Dieter Willner, senior staff, Group 34, Intelligence, Test and Evaluation Group, Lincoln Laboratory.

Innovative Solutions: Sabin Dang, technical assistant, McGovern Institute for Brain Research; Christine L. Moulen, library systems manager, MIT Libraries.

Unsung Heroes: Gary Pascucci, driver procurement and travel services, Lincoln Laboratory; George V. Petrowsky, systems administrator, Information Services & Technology; Patricia Shea, administrative staff, Group 61, Net-centric Integration Group, Lincoln Laboratory.

Two profs win DOE's Lawrence Award

Two MIT professors are among eight winners of the 2007 Ernest Orlando Lawrence Award from the U.S. Department of Energy.

The award, which consists of a gold medal, a citation and an honorarium of $50,000, honors scientists and engineers at mid-career for exceptional contributions in research and development that support the Department of Energy (DOE) and its mission to advance the national, economic and energy security of the United States.

Arup K. Chakraborty, the Robert T. Haslam Professor of Chemical Engineering and a professor of chemistry and biological engineering, won for the life sciences category of the award.

According to the DOE, he "has applied statistical mechanical methods to shed light on the molecular mechanisms that regulate the activation of T lymphocytes that orchestrate the immune response. His ground-breaking theoretical work has had widespread impact on experimental cellular and molecular immunology."

Moungi Bawendi, a professor in the Department of Chemistry, shares the award and honorarium in the materials research category with Paul Alivisatos of the University of California at Berkeley and E.O. Lawrence Berkeley National Laboratory.

Bawendi "developed a synthesis of semiconductor nanocrystals that was the first to enable precise control of their size and precise determination of their properties. Using the Bawendi synthesis, nanocrystals are now routinely made-to-order," according to the DOE.

In announcing the 2007 winners, Secretary of Energy Samuel W. Bodman (Sc.D. 1965) said: "These brilliant scientists and their varied and important research inspire us. Their work reminds us of the importance of continued investment in science and the need for increased emphasis on basic research and math and science education programs."

The Lawrence Award was established in 1959 to honor the memory of Lawrence, who invented the cyclotron (a particle accelerator), and after whom two major energy department laboratories at Berkeley and Livermore, Calif., are named. The Lawrence Awards, given in seven categories, will be presented at a ceremony in Washington, D.C.

Additional information is available on the web at www.sc.doe.gov/lawrence/.

Academy of Engineering elects 5 from MIT

Five MIT researchers are among the 64 new members of the National Academy of Engineering.

Election to the NAE is among the highest professional distinctions accorded to an engineer. Academy membership honors those who have made outstanding contributions to "engineering research, practice or education, including, where appropriate, significant contributions to the engineering literature," and to the "pioneering of new and developing fields of technology, making major advancements in traditional fields of engineering or developing/implementing innovative approaches to engineering education."

MIT's new members are:

George E. Apostolakis, professor of nuclear science and engineering and engineering systems, for "innovations in the theory and practice of probabilistic risk assessment and risk management."

James L. Kirtley Jr., professor of electrical engineering and computer science, for "contributions to the theoretical analysis, design and construction of high-performance rotating electric machinery."

Silvio Micali, professor of computer science and engineering, for "contributions to modern cryptography, through the development of zero-knowledge protocols and the theory of pseudo-randomness."

John N. Tsitsiklis, professor of electrical engineering and computer science, for "contributions to the theory and application of optimization in dynamic and distributed systems."

Timothy Berners-Lee, a senior research scientist at the Computer Science and Artificial Intelligence Lab, was named an NAE foreign associate for "development of the World Wide Web."

MIT study shows those who once were blind can learn to see

Anne Trafton
News Office

How does the human brain "learn" to see? If the brain is deprived of visual input early in life, can it later learn to see at all?

MIT researchers are exploring those questions by studying some unique patients—people who were born blind, or blinded very young, and later had their sight restored.

Doctors have long believed that children who were blind during a "critical period" early in life had little hope of learning how to see even if vision were later restored, so they were reluctant to offer potentially risky surgical treatments such as cataract removal to children older than 5 or 6.

However, in a recent case study, the MIT researchers found that a woman who had her vision restored at the age of 12 performed almost normally on a battery of high-level vision tests when they studied her at the age of 32. The study appears in the December issue of Psychological Science.

The new research "shows that the brain is still malleable" in older children, says Pawan Sinha, senior author and associate professor of brain and cognitive sciences at MIT. This knowledge could benefit thousands of blind children around the world, particularly in developing nations, who were previously thought to be too old to receive eye treatment.

The MIT researchers found their case study subject in India, where childhood blindness is a huge problem, and where Sinha recently launched a humanitarian initiative, Project Prakash, to help expand the reach of eye care facilities.

About 450,000 children in India are blind, and many of those cases are preventable. Most of the affected children live in remote areas where eye care is not available, so conditions that could be easily treated, such as cataracts, vitamin A deficiency or conjunctivitis, often lead to blindness.

In many such cases, blindness can be deadly: Blind children in India have a 15-year-shorter life expectancy than sighted children, and half of them die before the age of 5, according to Sinha. "Blindness essentially hastens death," he said. Some blind children are able to go to school, but "many live out their lives entirely dependent on other people's charity."

Through Project Prakash (Prakash means "light" in Sanskrit), the MIT researchers are making eye care available to blind children who would otherwise go untreated. The project has both humanitarian and scientific benefits—after treatment, the researchers study the children's progress, gaining insight into how the brain learns to see.

In the Psychological Science paper, the researchers studied a subject they encountered serendipitously—a 32-year-old woman who had had her sight restored at the age of 12. Known by her initials, S.R.D., the woman is the first subject of this kind who has been extensively studied, but there are other patients like her in India, says Yuri Ostrovsky, first author of the paper and a graduate student in brain and cognitive sciences.

Before her surgery, S.R.D. could distinguish between light and dark but could not make out form or pattern. Twenty years after the surgery, S.R.D.'s visual acuity was only 20/200, but the researchers were surprised to find that she showed normal or near normal abilities on most

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PHOTO COURTESY / **PAWAN SINHA**

MIT researchers Pawan Sinha, center, and Yuri Ostrovsky, right, test the visual skills of a patient in India. The patient, known as S.R.D., had her vision restored at the age of 12.

Gilliam fellowship winner is committed to research and public health outreach

Irene C. Blat, a research technician at the Broad Institute of MIT and Harvard, has received one of five 2007 Gilliam Fellowships from the Howard Hughes Medical Institute. The fellowships provide support for up to five years of study toward a Ph.D. in the life sciences for students

PHOTO / **KATHLEEN DOOHER**

Irene C. Blat

underrepresented in the sciences.

Gilliam fellows are selected from a pool of students who participated in HHMI's Exceptional Research Opportunities Program (EXROP), a program that offers research experiences for disadvantaged and minority undergraduates. Over the past four summers, 188 EXROP students have conducted research in the labs of HHMI investigators and professors.

The fellowships are named for the late James H. Gilliam Jr., a charter trustee of HHMI who spent his life fostering excellence and diversity in education and science.

Blat, a native of Charlotte, N.C., became interested in biology as a teenager helping her family resettle a group of Cuban refugees who had been granted political asylum in the United States. She witnessed the difficulty that immigrants had obtaining adequate medical care. This inspired Blat, whose family is from Venezuela and who speaks fluent Spanish, to become a volunteer translator at free medical clinics in Charlotte.

As part of her clinic work, Blat and other volunteers in Charlotte went door-to-door to educate members of the Latino community about health and disease. As an undergraduate biology major at Duke University, Blat continued volunteering to translate health information for the Hispanic community in Raleigh-Durham.

In the summer she spent in MIT Professor Tania Baker's lab, Blat studied MuB, a protein that regulates how a virus that infects cells using a strategy similar to the HIV virus interacts with the host cell DNA. She designed several mutants of MuB in which a specific amino acid was altered, in an attempt to understand the molecular interactions of the protein.

Baker was impressed that Blat took on this challenging biochemistry research project before she had even studied biochemistry. "She did beautifully, teaching herself biochemistry while carrying out her experiments," said Baker. "She clearly has what it takes to be a successful researcher."

After earning a B.S. in biology with a concentration in pharmacology, Blat became a research technician at the Broad Institute, where she worked on the Connectivity Map—a project overseen by HHMI investigator Todd Golub. Blat was an author on a paper about the project published in Science on Sept. 29, 2006. With her Gilliam fellowship, she plans to attend graduate school but has not yet decided on a program.

Although she wants to become an academic researcher, Blat has not lost the social conscience that first drove her to volunteer at the clinic in Charlotte. "It's important for researchers to be involved with what's going on in the community," she said.

PHOTO / **DONNA COVENEY**

Postdoctoral fellow Christian Reinhardt, left, and Professor Michael Yaffe of MIT's Center for Cancer Research have identified a defense mechanism that helps tumor cells survive chemotherapy.

CHEMO

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survival.) Up to 80 percent of human tumors lack p53, making them susceptible to the new treatment.

The researchers knocked out the inflammatory pathway, called the MK2 pathway, in mouse tumors using a technique known as RNA interference. When they did so in conjunction with low doses of common chemotherapy agents, such as cisplatin, they saw a dramatic reduction in tumor size. "The tumors basically melted away," says Yaffe.

In contrast to the growing tumors, the normal cells were unaffected. So "targeting MK2 would preferentially sensitize only the tumor tissue to chemotherapy, and spare patients the side effects from damaging healthy nontumor cells," explains Christian Reinhardt, a postdoctoral fellow in the Center for Cancer Research and first author of the study.

One such drug against the MK2 pathway is already in clinical trials. UCN-01, a compound identified in a NIH-sponsored screening of potential antitumor agents, is being tested against lymphoma and relapsed solid tumors. Some of the targets of UCN-01 are known, but until now, many of UCN-01's antitumor effects have not been explained.

Now that more of the mechanism behind UCN-01 is known, Yaffe hopes it will get more attention as a potential anticancer drug. He also hopes that researchers will try to identify other drugs that interfere with the same pathway.

Other authors on the paper are Aaron Aslanian, a postdoctoral fellow in the CCR, and Jacqueline Lees, professor of biology and associate director of the CCR.

The research is funded by the David H. Koch Fund and the National Institutes of Health.

Post-deep fry vegetable oil could power MIT vehicles

Deborah Halber
News Office Correspondent

MIT Dining's Fry-o-lators work almost around the clock to serve up French fries and chicken fingers. And every month, MIT pays $1.10 a gallon to cart away the used-up vegetable oil that made those fried foods taste so good.

A student-led initiative known as Biodiesel@MIT wants to see that dark brown waste liquid processed on campus into certifiable biodiesel and pumped into the tanks of MIT's growing number of diesel campus vehicles, such as the Tech Shuttles, which will soon use up to 30,000 gallons of diesel fuel a year, and others owned by the Department of Facilities.

The goal, according to Matt Zedler, a senior mechanical engineering major from Richmond, Va., is to have this up and running by April. It's ambitious, he admitted, but the group of around 20 students and administrators calling themselves Biodiesel@MIT is confident they can make it happen.

"MIT wants to 'walk the talk' on energy and the environment, and I believe that this project will pave the way for more student-led campus sustainability initiatives," said Joseph D. Roy-Mayhew, a junior chemical-biological engineering major who first looked into the feasibility of an on-campus biodiesel processor during a January 2006 IAP class sponsored by the Laboratory for Energy and the Environment. He further developed the idea with support from a Campus Sustainability UROP through the Environmental Programs Office. Zedler and more than a dozen others have since taken up the cause.

Biodiesel@MIT proposes to install a processor to convert used vegetable oil (UVO) to biodiesel and to later help plan a solar-powered fueling station where this local biodiesel would be available. The 20 percent bioderived fuel called B20 would be useable by most MIT diesel vehicles, all of which currently have to go off-campus to fuel up.

The up-front $15,000 price tag would buy a processor (although MIT students could build their own, the need for fuel certification and a short timeline led to the decision to purchase a commercial processor), pay for a system to collect the UVO from MIT Campus Dining and pay student operators to process the UVO. MIT would save $4,000 a year in UVO disposal costs and potentially save upwards of $12,000 a year in reduced petroleum diesel costs. Using vegetable-based diesel would also significantly reduce the amount of greenhouse gas emissions from MIT's diesel fleet.

The group entered its proposal for a solar-powered UVO processor as part of an on-campus filling station in a national contest sponsored by GE Ecomagination and

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PHOTO / **DONNA COVENEY**

Chemical engineering junior Joe Roy-Mayhew, left, and mechanical engineering senior Matthew Zedler offer up a vat of used cooking oil for use as biodiesel fuel.

PHOTO / **DONNA COVENEY**

MIT Professor Franz-Josef Ulm and postdoc Georgios Constantinides have shown that the strength of concrete lies in the way its nanoparticles are organized—like oranges stacked in a supermarket. Their findings could lead to a reduction in carbon dioxide emissions during concrete manufacturing.

CONCRETE

Continued from Page 1

refers to this work as the "identification of the geogenomic code of materials, the blueprint of a material's nanomechanical behavior."

Cement is manufactured at the rate of 2.35 billion tons per year, enough to produce 1 cubic meter of concrete for every person in the world. If engineers can reduce carbon dioxide emissions in the world's cement manufacturing by even 10 percent, that would accomplish one-fifth of the Kyoto Protocol goal of a 5.2 percent reduction in total carbon dioxide emissions.

Ulm considers this a very real possibility.

He and Georgios Constantinides, a postdoctoral researcher in materials science and engineering, studied the behavior of the nanostructure of cement. They found that at the nano level, cement particles organize naturally into the most densely packed structure possible for spher-

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Reactor upgrades help researchers study nuclear fusion as energy source

Anne Trafton
News Office

For about six months of the year, bursts of a hot, electrically charged gas, or plasma, swirl around a donut-shaped tube in a special MIT reactor, helping scientists learn more about a potential future energy source: nuclear fusion.

During downtimes when the reactor is offline, as it is right now, engineers make upgrades that will help them achieve their goal of making fusion a viable energy source—a long-standing mission that will likely continue for decades.

MIT's reactor, known as Alcator C-Mod, is one of several tokamak plasma discharge reactors in the world. Inside the reactor, magnetic fields control the superheated plasma (up to 50 million degrees Kelvin) as it flows around the tube.

Fusion occurs when two deuterons, or one deuteron and one triton—nuclei of heavy hydrogen—fuse, creating helium and releasing energy. The reactions can only occur at extremely high temperatures.

Although MIT's reactor is smaller than others, it has a stronger magnetic field than some larger reactors, allowing the plasma to become denser at comparable temperatures. "That positions us to provide important data you can't get anywhere else," said Earl Marmar, head of MIT's Alcator C-Mod project and senior research scientist in the Department of Physics.

One major goal of the upgrades is to create a system where plasma can flow in a steady state, rather than short pulses, or bursts.

Last year, engineers added a microwave generator that creates phased waves that flow around the ring, reinforcing the plasma current. The microwaves interact with the highest velocity electrons in the plasma, pushing them around the ring.

"It's possible to use this approach to go to fully steady-state plasma," Marmar said. "As an attractive energy source, ultimately we want steady state."

Benefits of a steady-state system include a constant energy output, less need for energy storage and less stress on the system, he said.

This year's modifications include the installation of a cryopump, which will allow scientists to control the density of the plasma over a long period of time—another necessary step to achieving a steady-state flow.

Several other modifications will allow the researchers to more accurately measure properties of the plasma, such as density and temperature. The new devices will also allow them to more accurately detect and measure magnetic and electric fields generated by the plasma.

The reactor, which has been offline for upgrades since August, is expected to be ready to use again starting in March.

More than 100 MIT researchers from the Departments of Physics, Nuclear Science and Engineering, and Electrical Engineering and Computer Science, including about 30 graduate students, use the Alcator C-Mod reactor to run experiments.

On a recent morning, the control room, normally packed with scientists at about 100 computer monitors, was nearly empty while engineers, scientists and students worked on modifications to the reactor, located in the next room.

When experiments are going on, researchers from

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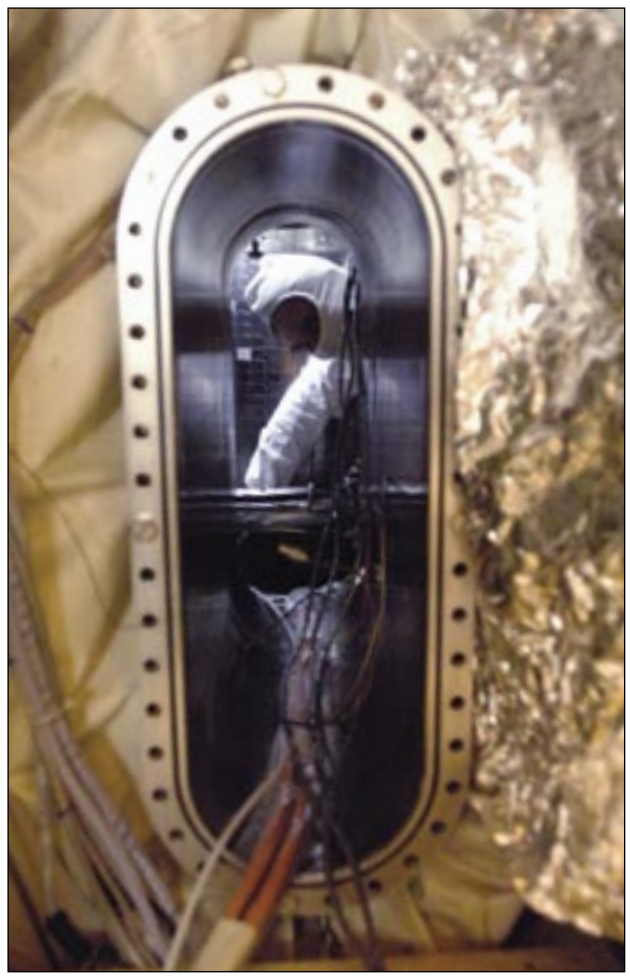

PHOTO / **DONNA COVENEY**

Shyri Marazita, an engineer at the MIT Plasma Science and Fusion Center, peers out of the Alcator C-Mod vacuum vessel. He is installing a liquid-helium-cooled cryopump, which will help the reactor achieve a steady-state plasma flow.

Lemelson winner designs for public safety

Nathan Ball, graduate student in mechanical engineering and this year's winner of the $30,000 Lemelson-MIT Student Prize, has invented a device that makes the fantasy of leaping tall buildings in a single bound come close to reality.

With the help of Ball's Atlas powered rope ascender, a fully loaded firefighter could reach the top of a 30-story building in only 30 seconds, compared to the six minutes or more it often takes to trudge up stairs with 80 to 100 pounds of equipment. The device, which is the size of a hand-held power tool, can lift a 250-pound load more than 600 feet into the air at nearly 10 feet per second, all on a single battery charge.

The novel aspect of the Atlas ascender is its rope-handling mechanism. Similar to the way an anchor is raised and lowered on a ship, the device relies on the capstan effect, which produces a tighter grip each consecutive time a rope is wrapped around a cylinder. The grip continues to tighten as more weight is applied to the line.

In his design, a standard-sized rope (between three-eighths and five-eighths of an inch in diameter) is woven between a series of specially configured rollers that sit on top of a turning spindle. As the battery-powered spindle rotates, it continuously pulls rope through the device. "We currently have three patents pending for the rope interaction and other iterations on the device," said Ball.

Ball envisions his invention having practical applications in rescue work, recreational climbing and cave exploration, as well as urban warfare situations. "It can help people complete tasks more efficiently and without depleting energy they would otherwise use climbing ladders and carrying heavy gear," he said.

Another of Ball's stand-out inventions is an improvement in the needle-free injection technology developed at MIT's BioInstrumentation Laboratory. Under the direction of his advisors Ian W. Hunter and Andrew Taberner in the BioInstrumentation Laboratory, Ball was challenged to use the lab's novel Lorentz-force actuator to create a dual-action, rapid-fire delivery technology that increased drug volume delivery.

Ball and his colleagues anticipate the needle-free injection technology, now awaiting livestock trials, having applications in animal husbandry.

Merton Flemings, director of the Lemelson-MIT Program, which sponsors the annual award, said, "His battery-powered rope ascender and needle-free injection technology both have life-saving capabilities and many commercial applications."

Ball's interest in invention does not stop with his own creations; he dedicates himself to mentoring and advising aspiring inventors. He is also involved as a technical advisor and co-host of "Design Squad," a new engineering-based reality show for children ages 9 to 13 that will air nationally on PBS beginning this month.

More information on the Lemelson-MIT Program is online at web.mit.edu/invent/.

BIOFUELS

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ate Committee on Energy and Natural Resources. "There is no single silver bullet that will make a robust transportation fuels industry a reality."

Most of the 5 billion gallons of ethanol produced annually in the United States comes from corn, but there's not enough corn available to make it a viable long-term source, according to Stephanopoulos.

Right now, about 16 percent of the U.S. corn crop is going into ethanol production, but the fuel makes up less than one percent of U.S. demand for liquid fuels, once you take into account the amount of energy needed to produce the ethanol, Stephanopoulos said. Even if all U.S. corn went into ethanol production, there would only be enough for 4 to 5 percent of U.S. annual liquid fuel consumption.

To replace corn, scientists are turning to cellulose found in grasses and agricultural wastes. In his Science article, Stephanopoulos outlined several challenges to producing ethanol from cellulose and avenues that research scientists are pursuing to overcome them.

"The technology to produce cellulosic ethanol is not there yet," he said. However, he estimates that large-scale, economically feasible production of ethanol from cellulose could happen within 10 to 15 years.

One of the major advantages of cellulosic material is its abundance, according to Stephanopoulos. He cited a recent Department of Energy report that estimated the United States could sustainably produce about 1.4 billion tons of such material per year.

"If we can convert that into liquid fuel, that could become a pretty significant percentage of liquid fuels in the U.S.," he said.

In addition, the energy balance in making ethanol from cellulosic material is much more favorable than producing ethanol from corn.

There are two major steps to producing ethanol from plant energy crops and agricultural wastes. First, the plant material must be broken down into its main components (cellulose and hemicellulose), which is done by treatment with heat, acid, ammonia or steam. In the second step, the cellulose is broken down into sugars, such as glucose, and fermented into ethanol. That is usually done by yeast or other microorganisms.

To maximize efficiency, scientists need to improve both the amount of plant material that can be produced per acre and the amount of ethanol that can be produced from the biomass, Stephanopoulos says.

Current lines of research described in his Science article include:

- Engineering grasses that can grow at high density, in close proximity to biofuels processing facilities.
- Engineering microbes that can efficiently process the two types of sugars commonly found in plant biomass—hexoses and pentoses.
- Consolidating the ability to break down cellulose and ferment sugar into ethanol in a single microorganism—"That would be a wonderful possibility, to have a single reactor," Stephanopoulos said.

Last year, Stephanopoulos and MIT colleagues reported that they had developed a new way to engineer the genome of yeast to produce desirable traits—in that case, the ability to tolerate high levels of ethanol, which is normally toxic to yeast. The technique holds promise for the development of other traits that would make yeast a more efficient ethanol producer.

In her prepared statement during last week's Senate hearing, Prather pointed to that study as an example of the kind of research that needs to be done if the United States wants to commit to converting to alternative fuels like ethanol.

"If we're going to be serious about it, the government has to be serious about funding long-term research about how we're going to transform our infrastructure—our economy, really," Prather said this week.

Prather emphasized to the committee that the development of biofuels is a "systems problem, meaning that there are a lot of components and each one has an impact on all the others."

While some researchers pursue genetic manipulation of microorganisms, they also need to coordinate with others involved in fuel production and consumption—for example, engineers designing new engines and agricultural scientists working with new crops.

"Those are conversations that have to be had all along the pipeline," Prather said.

Her other primary message to the committee was that while ethanol is promising, other potential biofuels, such as biodiesel, butanol and hydrogen, should not be excluded from study.

Ethanol has only 70 percent of the energy density of gasoline, making it less efficient, and its tendency to absorb water makes corrosion a concern for the current U.S. petroleum storage and distribution network, she said.

"A broader vision should include the possibility of alternative biomass-derived fuels with better physical properties and better integration into the infrastructure—that is, fuels that will work in existing cars and which can be transported through existing networks," she told the committee.

CONCRETE

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ical objects, which is similar to a pyramid-shaped pile of oranges.

Cement, the oldest engineered construction material, dating back to the Roman Empire, starts out as limestone and clay that are crushed to a powder and heated to a very high temperature (1500 degrees Celsius) in a kiln. At this high temperature, the mineral undergoes a transformation, storing energy in the powder. When the powder is mixed with water, the energy is released into chemical bonds to form the elementary building block of cement, calcium-silicate-hydrate (C-S-H). At the micro level, C-S-H acts as a glue to bind sand and gravel together to create concrete. Most of the carbon dioxide emissions in this manufacturing process result from heating the kiln to a temperature high enough to transfer energy into the powder.

Ulm and Constantinides gathered a wide range of cement pastes from around the world, and, using a novel nano-indentation technique, poked and prodded the hardened cement paste with a nano-sized needle. An atomic force microscope allowed them to see the nanostructure and judge the strength of each paste by measuring indentations created by the needle, a technique that had been used before on homogenous materials, but not on a heterogeneous material like cement.

To their surprise, they discovered that the C-S-H behavior in all of the different cement pastes consistently displays a unique nanosignature, which they call the material's genomic code. This indicates that the strength of cement paste, and thus of concrete, does not lie in the specific mineral, but in the organization of that mineral as packed nanoparticles.

The C-S-H particles (each about five nanometers, or billionths of a meter, in diameter) have only two packing densities, one for particles placed randomly, say in a box, and another for those stacked symmetrically in a pyramid shape (like a grocer's pile of fruit). These correspond exactly to the mathematically proved highest packing densities allowed by nature for spherical objects: 63 and 74 percent, respectively. In other words, the MIT research shows that materials pack similarly even at the nano scale.

"The construction industry relies heavily on empirical data, but the physics and structure of cement were not well understood," said Constantinides. "Now that the nano-indentation equipment is becoming more widely available—in the late 1990s, there were only four or five machines in the world and now there are five at MIT alone—we can go from studying the mechanics of structures to the mechanics of material at this very small scale."

If the researchers can find—or nano-engineer—a different mineral to use in cement paste, one that has the same packing density but does not require the high temperatures during production, they could conceivably cut world carbon dioxide emissions by up to 10 percent.

This aspect of the work is just beginning. Ulm estimates that it will take about five years, and says he's presently looking at magnesium as a possible replacement for the calcium in cement powder. "Magnesium is an earth metal, like calcium, but it is a waste material that people must pay to dispose of," he said.

He recently formed a research team with colleagues in physics, materials science and nuclear engineering. Ulm's research was funded in part by the Lafarge Group.

New DUE office will support innovation

Anna Babbi Klein
Office of the DUE

The Office of Educational Innovation and Technology (OEIT) has been established as part of the Office of the Dean for Undergraduate Education (DUE) as an important step toward supporting and sustaining educational innovation at MIT. OEIT will provide end-to-end support for innovation; its formation represents an important step in MIT's support for educational innovation through productive application of technology.

By creating OEIT as part of DUE, which also encompasses the Teaching and Learning Lab and the Office of Faculty Support, a natural synergy has been created that enables DUE to develop and promote innovative educational practices at MIT. DUE also administers the D'Arbeloff funds and Alumni Funds for the support of faculty educational innovation. OEIT reinforces DUE's commitment to serving as a catalyst for learning, exploring and discovering at MIT.

In making the announcement, Daniel Hastings, dean for undergraduate education, said that DUE will now offer faculty "services to enable educational innovation, including technology and assessment with a transition to sustaining services."

OEIT is a critical component of these services. OEIT will collaborate with faculty, students and staff to identify, develop and distribute innovative uses of educational technology at MIT. With strategic guidance from the MIT Council on Educational Technology, OEIT will communicate the availability of new educational innovations to faculty as well as facilitate the adaptation and adoption of innovations to

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BIODIESEL —

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mtvU, MTV's 24-hour college network, in which college students from around the country were asked to develop new, creative ways to green their campuses.

Biodiesel@MIT is one of 10 finalists that mtvU profiled online and on air on Feb. 12.

In March, judges will select the winner. Projects will be judged on ecology, economics and creativity. The winning school will receive a $25,000 grant and a free mtvU concert by the group Angels and Airwaves on Earth Day in April 2007.

If MIT wins the grant, it would go toward a biodiesel processor in a solar-powered filling station. Even if they don't win, the group hopes to install a biodiesel processor on campus until more funding is secured. MIT Facilities is developing a proposal for an on-campus filling station, and, if that goes forward, the biodiesel processor could be incorporated.

The biodiesel project would be a tangible contribution toward the "campus as learning laboratory" aspect of the MIT Energy Initiative established by President Susan Hockfield in the fall. Zedler envisions professors using the processor-fueling station for research or as part of a class; mechanical engineering students using the facility to test different kinds of engines with the alternative fuel; and chemical engineering students seeing first-hand how such processors work.

Eventually, Zedler said, the system may be expanded to make an ever-greater dent in MIT's overall $50 million annual energy budget, especially as more of the university's shuttles convert to diesel. "Recycling used vegetable oil on MIT's campus represents an initial stride toward more sustainable campus operations, and I feel the level of support for this project shows the desire for such on-campus greening projects," Zedler said.

"We keep looking for new ways to create and store energy, yet we often don't look at how we could use what we already have more efficiently or in unorthodox ways," Roy-Mayhew said.

Scientists swear a good lie detector is hard to find

Deborah Halber
News Office Correspondent

In the not-too-distant future, police may request a warrant to search your brain.

This was said only partly in jest by one of the panelists at a Feb. 2 symposium, "Is There Science Underlying Truth Detection?" sponsored by the American Academy of Arts and Sciences and the McGovern Institute for Brain Research at MIT.

The symposium explored whether functional magnetic resonance imaging (fMRI), which images brain regions at work, can detect lying. "There are some bold claims regarding the potential to use functional MRI to detect deception, so it's important to learn what is known about the science," said Emilio Bizzi, president of the American Academy of Arts and Sciences, an investigator at MIT's McGovern Institute for Brain Research and one of the organizers of the event.

At least two start-up companies claim to be able to use fMRI to detect deception. The companies plan to market their services to law enforcement and immigration agencies, the military, counterintelligence groups, foreign governments and corporations that want to screen applicants.

Not so fast, said panelist Nancy Kanwisher, the Ellen Swallow Richards Professor of Brain and Cognitive Sciences at MIT and an investigator at the McGovern Institute.

While her own research shows that you can accurately predict from fMRI data whether a person is thinking about a place or a face, Kanwisher thinks that neither the technology nor our understanding of the brain is sufficiently advanced to tell when a person is lying.

Emilio Bizzi

Nancy Kanwisher

In 2005, two separate teams of researchers announced that their algorithms had been able to reliably identify "neural signatures" that indicated when a subject was lying. But the research, conducted on only a handful of subjects, was flawed, Kanwisher said.

Subjects were asked to lie about whether they were holding a certain card or whether they had "stolen" certain items. These are not actually lies, she pointed out, because subjects were asked to make such statements.

"In the real world, the stakes are higher. If a subject believes the fMRI could be used against him or send him to prison, this would cause extreme anxiety whether the individual is guilty or not guilty," potentially influencing their patterns of brain activity, she said.

In addition, the subject may not want to cooperate. "FMRI results are garbage if the subject is moving even a little bit. A subject can completely mess up the data by moving his tongue in his mouth or performing mental arithmetic," she said. Testing also poses problems. To ensure accurate results, fMRIs would have to be tested on a wide variety of people, some guilty and some innocent, and they would need to believe that the data would have real consequences on their lives. The work would need to be published in peer-reviewed journals and replicated without conflicts of interest.

In short, Kaniwsher said, "There's no compelling evidence fMRIs will work for lie detection in the real world."

Panelist Jed Rakoff, a United States district judge in New York, said that, eventually, neuroscience may have a significant impact on the legal system, but fMRI could do little to ferret out what he said is the "biggest form of lying—omission. The practiced liar doesn't tell falsehoods, just omits key facts that would give a different spin."

HOUSING

Continued from Page 1

larly after the dot-com bust. Yet as Wheaton demonstrated through a series of graphs and charts that compared predictions with reality, in cities like Phoenix, Denver and Las Vegas, housing prices rose, sometimes spectacularly, in those years.

"The model says we should have seen (lower) housing prices. But in Phoenix, they went up 80 percent. Eighty percent!" Wheaton said.

Similar increases in Southern California, Florida and Washington seemed "totally unexplainable."

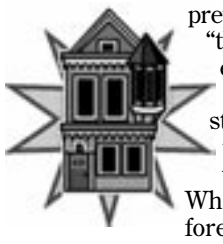
Wheaton, who helped organize the MIT Center for Real Estate, outlined two hypotheses that he says explain 65 percent of the model error.

One factor is an increase in the purchase of second homes. In the last two years, two million housing units were built, with only 1.25 million new household units, meaning a huge number of people are buying second homes, either as investments or residences. "People are buying housing that the economy, in some sense, doesn't need," he said.

The other factor is the emergence of the subprime lending market in the 1990s. Subprime loans, which charge high interest rates and are often held in a high-risk pool, are usually made to those with bad credit or who do not want to make a down payment. Such loans "push the envelope" of home ownership, Wheaton said.

From 1994 to 2005, the stock of subprime loans rose from 1 to 8 percent of the nation's total mortgage debt. Home ownership is rising, even though the national poverty rate is about 22 percent. "People technically in poverty are owning homes," Wheaton said. Since 1995, five million renters have become homeowners.

Now, if second-home buyers decide they prefer the stock market to real-estate investment and seek to unload their extra properties, that could be part of a "perfect storm" of factors that send housing prices tumbling, Wheaton said. But second-home sellers are generally more willing to hold out for higher prices than those who need to sell a home because they are buying a new one, preventing prices from softening. However, "this is new territory for us real estate economists," Wheaton said.



More worrisome in the "perfect storm" scenario is what will happen to those first-time homeowners hit by variable rates on their subprime loans. What if the five million recent buyers were foreclosed upon? They would be forced back into the rental market. (Indeed, Wheaton speculates that some apartment owners are anticipating this.) However, banks are beginning to work proactively with homeowners in trouble to stave off foreclosure.

Bottom line: Wheaton predicts an eventual 20 percent decline in housing prices. (That would include Boston, he said in answer to an audience question.)

This 20 percent drop in housing value represents a 40 percent drop in equity or wealth of the average homeowner, because so much American wealth is tied up in real estate. That would, he said, lead to a 2 to 3 percent drop in consumption because people tend to spend according to their perceived wealth.

However, we would probably grow out of a 3 percent decline in consumption in two to three years, he said. "It's just not enough to cause a recession." But, according to Wheaton, the formulation underscores the need for new thinking—that lower housing prices might cause a recession, rather than a recession lowering housing prices.

Of course, many in the audience had just one question: Should I buy now?

"I would tend to wait; I don't think the bottom has been reached," Wheaton said. "When the bottom hits, it's not going to zing back. You're not going to miss the bottom."

PHOTO / **SALLY PEACH**

Pi in the sky

"Amorous Intent: Looking for Love at MIT," the second annual student exhibition exploring themes of love, opens with a Valentine's Day reception today (Feb. 14) from 6 to 8 p.m. at the Wiesner Student Art Gallery. The show can be seen through Wednesday, March 7. The gallery, located on the second floor of the Student Center, is open 24 hours a day.

DUE

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improve teaching and learning at MIT. Finally, OEIT will collaborate with educational technology service providers, such as Information Services and Technology (IS&T) and the MIT Libraries, to ensure that innovative technology applications are supported as sustainable services.

The Office of Educational Innovation and Technology is led by Vijay Kumar, senior associate dean in DUE, and is staffed primarily by educational consulting and software development groups formerly in the Academic Computing group from IS&T.

To get more information, please visit the interim OEIT web site at web.mit.edu/due/OEIT.htm. To contact OEIT, please e-mail oeit-lt@mit.edu or call 617-252-1981.

REACTOR

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around the world can participate in and watch the proceedings through the Internet.

There is high demand for time to run experiments on the reactor, but priority is given to projects that have high relevance to the Alcator goals and also to MIT graduate student research projects.

"One of our highest priorities is to get graduate students the run time they need," Marmar said.

For more information on the Alcator project, visit www.psfc.mit.edu/research/alcator/.

BLINDNESS

Continued from Page 4

tests of high-level vision, including recognizing objects and faces, judging depth order and matching 2-D and 3-D shapes.

One task where she did not do well was the gaze-estimation test, where she based her answers on where people's heads were pointed, not where their eyes were looking. She also seemed to take longer to perform some of the tasks, and she had trouble visualizing objects with her eyes closed, said Ostrovsky.

S.R.D. had no explicit training after her surgery, so she had to learn by experience. Because of the 20-year lag between her sight restoration and initial testing by the researchers, they don't know how much time it took her to reach her present level. "It's hard to get the full picture," said Ostrovsky.

Still, the findings have significant implications for the idea of a "critical period" for learning how to see, says Sinha. There are few data from human subjects regarding such a critical period, but studies with other animals such as kittens have suggested that visual recovery is very limited following a few initial months of rearing in complete darkness. Extrapolating these findings to humans would lead one to conclude that treating blind children after a few years of age would be of very limited use.

However, evidence from the case of S.R.D. and others suggests that the visual cortex retains its plasticity, or ability to learn new functions, well into childhood.

Those early results have already had an impact on how doctors view childhood blindness. Ophthalmologists working with the MIT team in India are now more willing to treat older patients, which they previously thought would be hopeless.

"Before our collaboration with them, they would be very reluctant to treat children older than 5 or 6 years of age, but now they are much more willing to identify older children and treat them," Sinha said.

After completing their case study, the researchers received the distressing news that S.R.D. had met with an accident while taking her 9-year-old daughter to the eye clinic. She fell while getting off a bus and was pulled under the wheels, and died of her injuries. The researchers plan to contribute funds to help her daughter, who is now living by herself in a hostel for the blind, and other blind children who often end up neglected by society.

MIT graduate student Aaron Andalman of brain and cognitive sciences is also an author on the Psychological Science paper. The research was funded by the Merck Scholars Fund and the National Eye Institute.

In other ongoing studies, the researchers hope to track the precise order and mechanism of visual skill development following sight restoration.

PHOTO / **DONNA COVENEY**

Pawan Sinha, associate professor of brain and cognitive sciences, has been named the 2007 recipient of a Troland Research Award. The $50,000 awards, granted by the National Academy of Sciences, are given annually to two researchers to recognize and support research in psychology regarding the relationships of consciousness and the physical world. Sinha was chosen "for elucidating how humans learn to recognize visual objects." The Troland Research Awards were established by a bequest from Leonard T. Troland and have been presented since 1984.

Flow of tiny bubbles mimics computer circuitry

Microfluidic research could boost capabilities of 'lab on a chip' devices

Anne Trafton
News Office

In work that could dramatically boost the capabilities of "lab on a chip" devices, MIT researchers have created a way to use tiny bubbles to mimic the capabilities of a computer.

The team, based at MIT's Center for Bits and Atoms, reports that the bubbles in their microfluidic device can carry on-chip process control information, just like the electronic circuits of a traditional microprocessor, while also performing chemical reactions. The work appeared in the Feb. 9 issue of Science.

"Bubble logic merges chemistry with computation, allowing a digital bit to carry a chemical payload. Until now, there was a clear distinction between the materials in a reaction and the mechanisms to control them," said co-author Neil Gershenfeld, director of the Center for Bits and Atoms.

Microfluidics allows scientists to create tiny chips where nanoliters of fluids flow from one part of the chip to another, undergoing controlled chemical reactions in different parts of the chip and replacing the conventional test tubes and glassware used for chemistry for centuries.

The technology has the potential to revolutionize large-scale chemical analysis and synthesis, environmental and medical testing and industrial production processes, but applications outside of the laboratory have been limited so far by the external control systems—valves and plumbing—required for its operation.

But now, the MIT researchers are able to control microfluidic chips via the interactions of bubbles flowing through microchannels, eliminating the need for external controls. "Now you can program what's happening inside the lab on a chip, by designing bubble logic circuits that function just like their electronic counterparts," said Manu Prakash, Gershenfeld's co-author and graduate student.

Controlling chemical reactions will likely be a primary application for the chips, according to the researchers. It will be possible to create large-scale microfluidic systems such as chemical memories, which store thousands of reagents on a chip (similar to data storage), using counters to dispense exact amounts and logic circuits to deliver them to specific destinations.

Other applications include combinatorial synthesis of many compositions at the same time, programmable print heads that can deposit a range of functional materials, and sorting biological cells.

The researchers modeled their new microfluidic chips on the architecture of existing digital circuits. But instead of using high and low voltages to represent a bit of information, they use the presence or absence of a bubble. They report on nitrogen bubbles in water, but any other combinations of materials that don't mix would work, such as oil and water.

In the Science paper they demonstrate all of the elements needed for any new logic family, including gates, memories, amplifiers and oscillators. The speed of operation is about 1,000 times slower than a typical electronic microprocessor, but 100 times faster than the external valves and control systems used in existing microfluidic chips. Gershenfeld and Prakash anticipate that its invention will allow existing circuit designs (and designers) to work in the domain of microfluidics.

The research was supported by MIT's Center for Bits and Atoms, an interdisciplinary initiative exploring the boundary between physical science and computer science, with funding from the National Science Foundation.

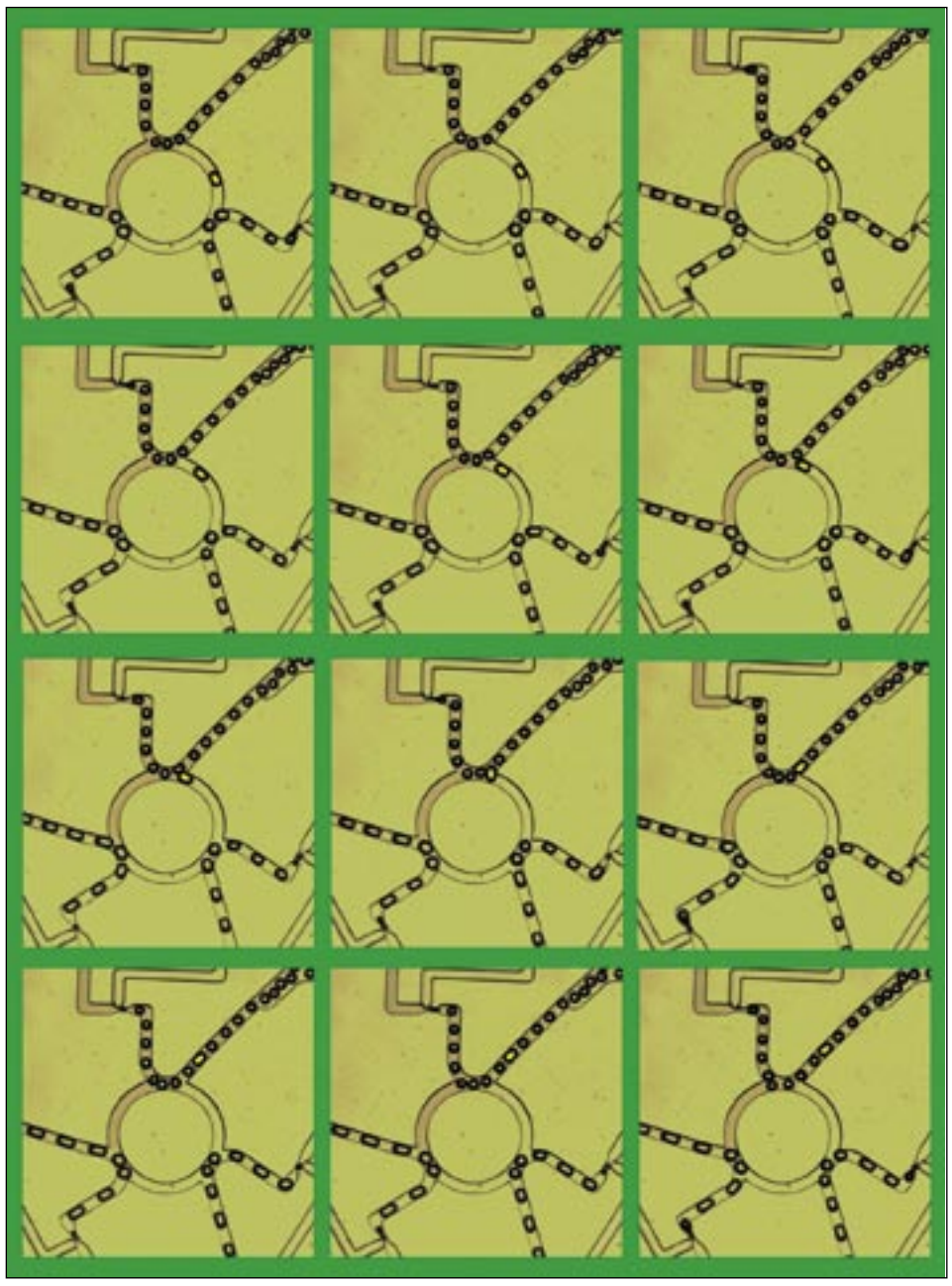

IMAGE / **FELICE FRANKEL AND MANU PRAKASH**

A colored montage of a ring oscillator used in the microfluidic computer developed by researchers at MIT. Starting with top left image, and reading left to right, the yellow bubble flows around the ring until it reaches and joins a stream of bubbles.

PHOTO COURTESY / **MANU PRAKASH**

The computer chip developed at MIT runs on microbubbles like these.

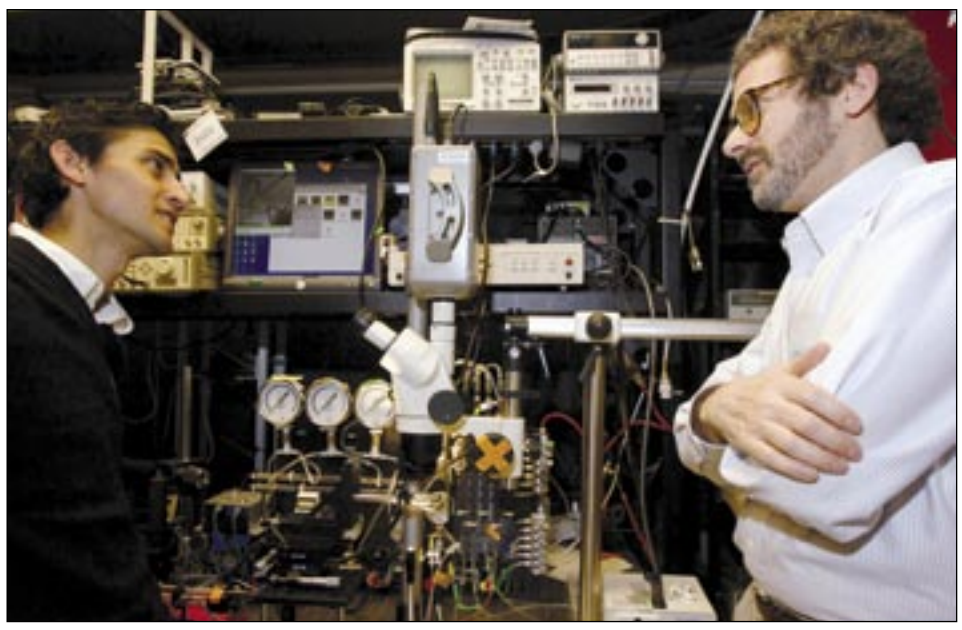

PHOTO / **DONNA COVENEY**

Graduate student Manu Prakash, left, and Professor Neil Gershenfeld discuss new applications for their microfluidic chips, which can carry on-chip process control information.

'DEVELOP' exhibit shows work by Yung Ho Chang and his Beijing firm

MIT's first exhibition of work by Yung Ho Chang, head of the Department of Architecture, and his Beijing-based firm, Atelier FCJZ, opens at the Wolk Gallery (Room 7-338) with a reception tomorrow (Feb. 15) at 5:30 p.m.

Chang joined the MIT faculty in 2005. He is internationally acclaimed for a broad range of work, including urban design proposals, large structures for government use, private residences and a number of exhibitions at international art venues, including the Venice Biennale.

"DEVELOP: The Architecture of Yung Ho Chang/Atelier FCJZ" is displayed in three PowerPoint presentations, superimposed with the popular 2002 Hong Kong film noir trilogy, "Wu Jian Dao" ("Infernal Affairs"), which was produced in 2006 in the United States as Martin Scorsese's "The Departed."

According to Chang, the title of the three projections could literarily suggest "infernal construct."

"While symbolically the title may imply our constant struggle," said Chang, "the real purpose of the overlap of architecture and cinema is to place our work in a context, geographically, temporally and culturally, a context that blurs reality and fiction yet is not far from our frantic experience in China. Furthermore, it reveals that our anchoring in basic architecture is ultimately strategic and it is a preparation for more involvement in making the broader contemporary Chinese cultural landscape."

The exhibition will be on view through April 13. Gallery hours are weekdays from 9 a.m. to 5 p.m.

PHOTO / **HE SHE**

PHOTO / **JUAN DU**

An MIT exhibit of design projects by Yung Ho Chang/Atelier FCJZ includes the Hebei Education Publishing House, Hebei, China (2004), at left, and 'Bamboo Shoot,' the Chinese Pavilion, Venice Biennale (2005).