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TechTalk

S E R V I N G T H E M I T C O M M U N I T Y

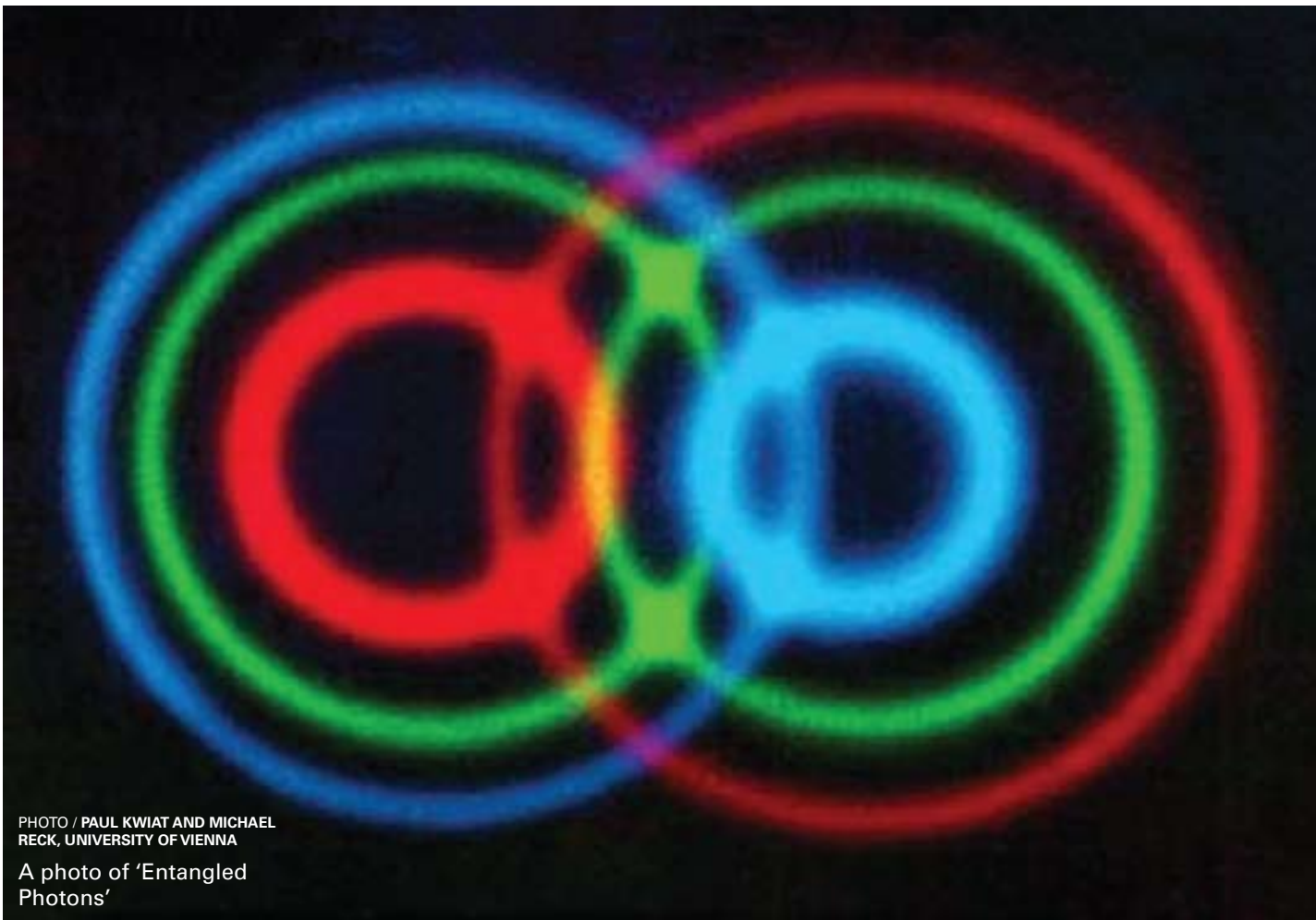


PHOTO / PAUL KWIAT AND MICHAEL RECK, UNIVERSITY OF VIENNA
A photo of 'Entangled Photons'

Odd quantum effect may spawn new applications

Improved efficiency could enable research, military and medical uses

David Chandler
News Office

A bizarre but well-established aspect of quantum physics could open up a new era of electronic detectors and imaging systems that would be far more efficient than any now in existence, according to new insights by a leader in the field.

MIT Professor of Mechanical Engineering Seth Lloyd has found that a peculiar quantum-physics property called entanglement can be harnessed to make detectors — similar in principle to radar systems used to track airplanes in flight or ships at sea — that are as much as a million times more efficient than existing systems. In addition, beams of entangled light could be swept across a scene to reconstruct a detailed image, with a similar improvement in efficiency.

The new findings, reported this month in the journal *Science*,

are purely theoretical, but Lloyd says that laboratory experiments have already proven the feasibility of both the light sources and the detectors needed for such a quantum-based photodetection system, so he anticipates that within a year it should be possible to build a laboratory-scale system to demonstrate the new concept.

"It should be possible to have at least a proof-of-principle demonstration within six months to a year," Lloyd said.

For example, military applications could include improved night-vision systems, which send out beams of infrared light — invisible to the naked eye — to sweep across a scene, and then use an infrared detector to reconstruct an image from the light that is reflected back. A more efficient system, using the quantum-entanglement effect, would make it much more difficult for an adversary to detect the fact that such a system was being

►Please see QUANTUM, PAGE 5

D'Oliveira to lead OpenCourseWare



PHOTO / PATRICK GILLOOLY
Cecilia d'Oliveira

Cecilia d'Oliveira '77, SM '79 has been named executive director of MIT OpenCourseWare, having led the groundbreaking organization on an interim basis for the past year, Provost L. Rafael Reif announced this week.

D'Oliveira will be responsible for leading OCW, the highly successful initiative that has published virtually the entire MIT undergraduate and graduate curricula online, in the next phase of its development. Reporting to the Office of the Provost, and with the assistance of a distinguished 18-member external advisory committee, d'Oliveira will guide the development of programmatic initiatives,

institutional partnerships and external support for OCW.

"With her strong technical background, decades of experience at MIT and proven ability to build and lead teams, Cecilia is ideally qualified to lead OCW as it enters an exciting, new phase. I look forward to working with her as we realize the full potential of the OCW web site," Reif said.

D'Oliveira said among her key goals as executive director is to make OCW as useful as possible for the MIT community while building on MIT's worldwide leadership in the field of open education.

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Solutions-driven culture draws Fallon to MIT

Veteran of global hot spots to share insights during fall CIS fellowship

Stephanie Schorow
News Office correspondent

He has been in all the world's hot spots in the last 40 years — both as soldier and commander — and now Admiral William J. Fallon brings his hands-on experience and wide-ranging knowledge to MIT's Center for International Studies (CIS).

Fallon, the former commander of U.S. Central Command and U.S. Pacific Command, joins CIS this fall as a Robert E. Wilhelm Fellow, bearing a breadth of knowledge gained from everything from flying combat missions during the Vietnam War to seeing action in the Balkans and the first Gulf War to overseeing U.S. military operations in Iraq and Afghanistan.

"Admiral Fallon brings to our researchers and students a wealth of experience at the highest level of strategic thinking in many of the world's most demanding assignments," says Richard Samuels, CIS director and Ford International Professor of Political Science.

Fallon, who led CENTCOM from March 2007 to March 2008, also paid a high price for his convictions, retiring after a magazine profile depicted him as challenging President George W. Bush's Iran policy.

With 41 years of distinguished service under his belt, Fallon, nicknamed "Fox," brings a personal knowledge of places and people on the world stage. Soft-spoken and reflective, Fallon nevertheless displays

►Please see FALLON, PAGE 3

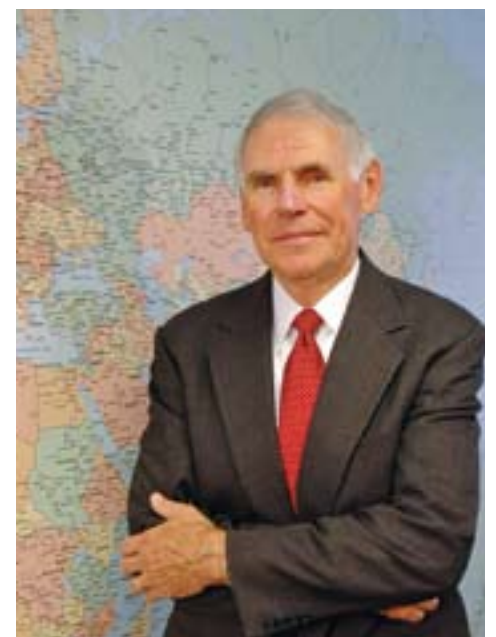


PHOTO / STEPHANIE SCHOROW

Admiral William J. Fallon

EVENTS

The calendar returns

A portion of MIT's online calendar will be published regularly in Tech Talk starting this week.

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RESEARCH

Flip the switch

MIT researchers await data from the LHC, which started up recently at CERN.

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NEWS

Hockfield urges Congress

MIT President Susan Hockfield testified before a House committee last week for more R&D funding.

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Events
at MIT

Today

• **MISTI Open House.** 12 p.m.–2 p.m. in W20-202. Where do you want to go next summer? Learn about internship and study opportunities available around the world through MISTI.
URL: mit.edu/misti

• **Faculty meeting.** 3:30 p.m. in Room 10-250. Agenda includes voting on Master in Management Studies resolution from the MIT Sloan School of Management, update on the Broad Institute and remarks from President Susan Hockfield.

• **Diversity Reception hosted by Cisco, Medtronic and Hewlett Packard.** 4-6 p.m. in 10-105. If you are an underrepresented minority student, this would be a great opportunity to meet with employers truly committed to hiring the best and the brightest.

Thursday, Sept. 18

• **The MIT Center for International Studies' Starr Forum,** "Foreign Policy and the next U.S. administration: America's defining moment." MIT Tang Center, E51-315, 70 Memorial Drive, Cambridge, 6 p.m. A roundtable discussion with MIT scholars Barry Posen, Carol Saivetz and Taylor Fravel.
URL: web.mit.edu/cis/eventposter_fp_next_us_admin.html

• **Compton Lecture** by His Excellency Paul Kagame, president of the Republic of Rwanda. Kagame's speech will focus on "The Imperative of Science and Technology in Accelerating African and Rwandan Development." Starts at 3:30 p.m. (doors open at 3:15 p.m.) in W16.
URL: <http://web.mit.edu/compton/>

• **MADMEC finals and awards.** In the Making and Designing Materials Engineering Contest (MADMEC), student teams create prototypes that develop or utilize alternative forms of energy using principles of materials science and engineering. Poster session at 6 p.m. in 6-104. Presentations at 7 p.m. in 6-120.
URL: <http://dmse.mit.edu/madmec>

• **Brandeis/Harvard/MIT/Northeastern Joint Mathematics Colloquium.** Jordan Ellenberg of the University of Wisconsin will speak. 4:30-5:30 p.m. in 4-237.

Saturday, Sept. 20

• **Alumni Leadership Conference 2008.** The annual Alumni Leadership Conference (ALC) includes leadership workshops, networking events, and useful information sessions related to various areas of volunteer activity. In addition, general sessions with senior Institute administrators provide volunteers with an insider's view of the latest happenings at MIT. The Institute's leadership awards are also celebrated during ALC.
URL: alum.mit.edu/ne/alc/index.html

OBITUARIES

Lucian W. Pye, leading
China scholar, 86

Retired MIT political science professor Lucian W. Pye, one of America's leading China scholars, died Sept. 5 in Boston after a long illness. He was 86.

Pye, Ford Professor of Political Science Emeritus at MIT, was a leader in studying the politics of modernization in the Third World. He was author or editor of more than 25 books including "Asian Power and Politics: The Cultural Dimensions of Authority," "China: An Introduction" and "Mao-Tse Tung." He served as a mentor to several generations of influential political scientists and as an active public intellectual and policy adviser to presidential candidates, including John F. Kennedy. In addition to serving as president of the American Political Science Association from 1988-89, Pye participated in a variety of private organizations where scholars, government experts and lay leaders met to discuss Asia-related research and policy. These included the Council on Foreign Relations, the U.S.-China Relations Committee and the Asian Foundation.

"Lucian was a giant in the intellectual world that went well beyond our field of political science," said Charles Stewart, head of MIT's Department of Political Science. "For anyone ever called 'hero' or 'scholar' by Lucian, we must now live up to those titles he so cheerfully bestowed upon us."

His dominant intellectual concern was to explore the cultural differences that help explain why the game of politics differs so greatly from one nation to another.

The unique understanding that he brought to his studies of China, in particular, came in part out of his experience of growing up as a child of Congregational



PHOTO COURTESY OF THE MIT MUSEUM

Lucian W. Pye

missionaries in Shansi Province, in northwest China. Born in 1921, he lived primarily in China until he went to Minnesota to attend Carleton College.

After graduating from Carleton, Pye returned to China at the end of World War II to serve as an intelligence officer in the 5th Marine Corps, achieving the rank of Second Lieutenant. He returned to the U.S. to attend graduate school on the GI Bill at Yale University. During these crucial years of Pye's intellectual formation, he was a part of a significant contingent of political scientists including Harold Lasswell, Nathan Leites and Gabriel Almond. Together, the group explored the psychological, sociological and anthropological elements of international affairs — a departure from the standard "realism" of the day. Almond, his mentor at Yale, recalled his student Pye as "generally leaving me a little breathless; he

had so much energy and enthusiasm."

Pye himself became an important mentor and teacher to scores of political scientists since his arrival at MIT in 1956, where he helped found the Department of Political Science. With his encouragement and oversight, many of his students have gone on to prominent positions in both academia and government.

He is survived by his wife, Mary, of Lexington, Mass., and his three children, Lyndy and Chris, both of Northampton, Mass., and Virginia, of Richmond, Va., as well as three grandchildren, Anna Swann-Pye and Eva and Daniel Ravenal. The family would like to encourage contributions to the Lucian W. Pye Memorial Graduate Fellowship Fund in the Department of Political Science at MIT. Memorial services will be held both in the town of Belmont, Mass., and at MIT at a future time.

AWARDS
& HONORSGallop named to CCTV's
Honorary Board

Sarah Gallop, co-director in the Office of Government and Community Relations, will be honored as Cambridge Community Television (CCTV) celebrates its 20th anniversary on Sept. 18. Gallop will be inducted alongside 19 other individuals as part of CCTV's first Honorary Board, which recognizes those who have demonstrated an unwavering commitment to CCTV's mission, providing guidance, advice and advocating on behalf of CCTV.

Díaz wins Dayton prize

MIT professor Junot Díaz has been named the winner of the Dayton Literary Peace Prize for fiction for his novel, "The Brief Wondrous Life of Oscar Wao," which garnered a Pulitzer Prize earlier this year. The Dayton Literary Peace Prize is the first and only annual U.S. literary award recognizing the power of the written word to promote peace.



PHOTO / STEPHEN MACLONE

Good Knight

The newest group of Knight science journalism fellows has descended upon MIT. Back row, left to right: Kathleen Boisvert, Knight assistant director; Philip J. Hiltz, Knight director; Dianne Finch; Sharon Weinberger; Molly Seamans; Marcin Rotkiewicz; Teresa Firmino; Karen Weintraub; Kimani Chege; Rachel Zimmerman; front row, left to right: Jonathan Fildes; Sascha Karberg; Alex Otto; Sabin Russell.

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Rwanda's Kagame to deliver Compton lecture

Rwandan President Paul Kagame, who as a boy had to flee his homeland to escape ethnic violence, will present the Karl Taylor Compton Lecture 18 from 3:30-5 p.m. on Thursday, Sept. 18, in MIT's Kresge Auditorium.

Kagame became president of the Republic of Rwanda in 2000, six years after the country was wracked by ethnic violence that left more than a million people dead. He had been the leader of the guerrilla Rwandan Patriotic Front, whose invasion of Rwanda helped end the Rwandan genocide of 1994.

Born a Tutsi in 1957, Kagame and his family moved to a Ugandan refugee camp in 1960 to escape the violence of a revolt sparked by the Belgian military and carried out by the Hutu population. Kagame later was among those launching a five-year liberation war in Uganda in 1980. In October 1990, Kagame returned to Rwanda after 30 years in exile to lead the Rwandan Patriotic Army. In 2000, he was elected president by the Transitional National Assembly; in 2003, he won Rwanda's first democratically contested multiparty elections.

Kagame has been lauded for his effort to bring stability and peace to Rwanda; his honors include the 2003 Global Leadership Award by the Young Presidents' Organization, the Andrew Young Medal, the Information and Communications Technologies Africa



Compton speakers include U.S. Sen. Jeff Bingaman of New Mexico and former NBC News anchor Tom Brokaw.

The lectures are sponsored by the MIT president, in conjunction with the Office of the Provost.

This event is free and open to the public. No tickets are required. For more information, please visit web.mit.edu/compton/index.html.

Award, the African National Achievement Award, the African Gender Award, and several honorary doctorates. He also received international recognition for outlawing the death penalty in Rwanda in 2007.

Kagame, who has pushed for initiatives in business, communications, energy and gender equity, will use his lecture at MIT to address the "Imperative of Science and Technology in Accelerating African and Rwandan Development."

The Karl Taylor Compton Lecture Series was established in 1957 to honor the late Karl Taylor Compton, who served as president of MIT from 1930 to 1948 and as chairman of the MIT Corporation from 1948 to 1954. The purpose of the lecture series is to give the MIT community direct contact with the important ideas of our times and with people who have contributed much to modern thought. Recent

Panel to address foreign challenges awaiting next president

Stephanie Schorow
News Office correspondent

How will the United States counter rising violence in Afghanistan? Should the U.S. military continue to draw down in Iraq? What should be done about Iran's nuclear ambitions, China's economic might and Russia's reawakened assertiveness?

Tough questions confronting the next American president will be discussed by MIT scholars from 6-7:30 p.m. on Thursday, Sept. 18, in a roundtable discussion on "Foreign Policy and the Next U.S. Administration: America's Defining Moment" at the Tang Center, E51-315.

The event, sponsored by MIT's Center for International Studies as part of its Starr Forum series, brings together Barry Posen, Ford International Professor of Political

Science at MIT and director of the CIS Security Studies Program; Carol Saivetz, CIS visiting scholar and research associate at Harvard University's Davis Center for Russian and Eurasian Studies; and Taylor Fravel, MIT associate professor of political science and member of the CIS Security Studies Program.

"Though economic issues loom large in the presidential campaign, and for good reason, foreign policy deserves equal billing," said Posen, who recently testified before Congress about a new grand strategy for the presidency. "The last seven years have not gone well: al Qaeda seems almost as strong now as it was when it first attacked the U.S.; significant military resources have been misdirected in Iraq; Afghanistan is a bloody stalemate; Iran's nuclear research and development programs proceed apace; Russia is no longer a weak and malleable remnant of the Soviet Union; China's economy grows rapidly; the tragedy in Darfur persists.

"The menu of foreign policy problems likely to face the next president is long, and

the resources to meet them are stretched thin," he said. "Hard choices will need to be made among foreign policy problems, and between foreign policy problems and domestic priorities. The presidential campaign could educate the public about these fundamental issues, but so far it has not."

The forum participants bring a wide range of expertise. Saivetz, an expert on Soviet and now Russian issues, is currently working on a book on Russian Prime Minister Vladimir Putin's foreign policy. Fravel, who studies international relations with a focus on international security, examined China security in his recent book, "Strong Borders, Secure Nations."

"In this forum we can illuminate the positions the candidates have too quietly taken, and the questions that we wish the candidates would discuss, and that we hope the press will begin to ask," Posen said.

The discussion is open to the public. For more information, please visit http://web.mit.edu/cis/eventposter_fp_next_us_admin.html.

FALLON: Admiral says MIT 'focused on solutions to problems'

Continued from Page 1

a military bearing and admits to being "pretty strongly opinionated."

Fallon says he wanted to come to MIT because the school was "focused on solutions to problems — and there's quite a few of them out there."

He rejects a sound-bite approach to foreign policy and hopes to impress upon students how many of the seemingly recent international problems result from centuries-old conflicts with ethnic, religious and historical overtones.

The antagonism between Georgia and Russia, for example, "was a tinderbox, and activities by both parties contributed to this." There was little — if anything — the United States could do, even if action was called for, he says.

Likewise, Fallon cautioned against a simplistic view of the resurgence of violence in Afghanistan. "I don't think you

can isolate Afghanistan from the region, certainly not now," he says. "Lots of folks are called Taliban, but this is not in my opinion some easy-to-identify, ideologically pure" group.

In Afghanistan, "authority has never been well done from the top down; there are lots of local issues. The idea that we from the outside can turn this place into a Garden of Eden is wishful thinking," he says. "Nonetheless we can play a significant role and we are doing a lot for these people — as are a lot of countries in the world."

Iraq's much-touted increase in security, likewise, has multiple causes. "The surge of additional forces helped, certainly," Fallon says. But just as important were "the changes in tactics, the way we went about doing business on the ground."

Specifically, "We actually got our people out to enforce security in some parts of the

country — particularly around Baghdad and in heavily populated and mixed areas, which were pretty lawless and all kind of militias were at play. Al Qaeda was instituting major trouble from Sunni areas; Iran was aiding and abetting militias on the Shia side and they were tearing the place apart."

Also: "The Iraqi people had just about had enough." They turned from active support or passive acceptance of insurgents to helping American forces, Fallon says.

Fallon envisions a continued draw-down of American forces in Iraq but he is very clear that a long-term security agreement between the two countries would be in the best interest of both. "There are many things the Iraqis are not quite capable of doing today. We can do them. They want to do them. They'll get there. But there needs to be an agreement in principle and then you can work on the details," he says.

AWARDS&HONORS

Sloan student wins prestigious award

Charles A. Gammal III, a graduate student in the MIT Sloan School of Management, was recently awarded the Outstanding Electrical or Computer Engineering Student Award by Eta Kappa Nu (HKN), the Electrical and Computer Engineering Honor Society. HKN recognizes one student nationally for the award.

Graduates named AAAS policy fellows

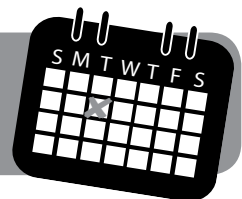
Three recent MIT graduates are among the newest group of AAAS Science & Technology Policy Fellows. The fellows — Federico San Martini SM '01, PhD '04; Marcus Sarofim '96, PhD '07; and Joyce Yang PhD '06 — are scientists and engineers from

early to senior career stages who spend a year working in federal agencies or congressional offices. They learn about science policy while providing valuable expertise and analysis to the executive and legislative branches of government.

Herr wins 'Spirit of da Vinci Award'

The National Multiple Sclerosis Society, Michigan Chapter, has named Hugh Herr associate professor in media arts and sciences, and health sciences and technology, the 2008 Spirit of da Vinci Award winner. The award is presented annually to an individual for their courage, perseverance and creative use of assistive technology.

Events
at MIT



Tuesday, Sept. 23

• **Washington Taylor**, MIT Professor of Physics, will present a lecture outlining his research in String Theory. 1-2:30 p.m. at Suffolk University's C. Walsh Theater, 55 Temple St., Boston.

• **2008 MIT Future of Mobility Conference**. 8 a.m.-5 p.m. in E51 (Wong Auditorium). This one-day conference will present a series of talks by experts in areas around the extrapolation of current trends in aspects of human mobility and the social implications for the future.
URL: <http://ilp-www.mit.edu/events/MOBILITY2008>

• **Energy Club Lecture**: Henri Daher, NSTAR—Demand Side Management in Lebanon. 6-7 p.m. E51-149. Daher will talk about his recent experiences in Lebanon as part of a UN mission to provide advise on electricity infrastructure investments.
URL: <http://www.mitenergyclub.org/>

Submit your events!

Log on to events.mit.edu to add your events to MIT's online calendar. Select events will be selected from the online calendar to be published in Tech Talk each Wednesday.

NEWS

IN BRIEF

Vendor fairs this week

The 10th Annual Travel Vendor Fair will be held from 10 a.m. to 2 p.m. on Tuesday, Sept. 23, in Lobby 13. Invitations will go out to all faculty, staff and support staff this week. Individuals who travel on MIT business or are responsible for making travel arrangements will find this event informative and fun.

On Thursday, Sept. 18, members of the MIT community are invited to visit with more than 100 suppliers/vendors of goods and services for MIT. Vendors will display products such as scientific/laboratory supplies, office supplies, copier equipment, computers, furniture, etc., and will be available to answer questions.

The event will take place under a tent on McDermott Court (outside Building 54 and Building 18) from 9 a.m.-2 p.m., rain or shine. Refreshments will be available. For more information, please contact Diane Shea, Director of Procurement, at dshea@mit.edu.

\$25K X-Prize offered for best 'green idea' video

It took the wealth of Microsoft co-founder Paul Allen to win the original \$10 million X-Prize four years ago, for the first privately financed craft to make it to space and back. But a smaller-scale X-Prize announced at MIT last week opens the door to anyone with a video camera.

The new competition, titled "What's Your Crazy Green Idea?", asks contestants to upload a two-minute video to YouTube, proposing a large X-Prize for work relating to energy and the environment. Judges will select three finalists, and the winner will be named in December.

The new prize was announced at last week's X-Prize Energy Forum, which featured talks by inventor Ray Kurzweil '70, geneticist George Church of Harvard, inventor Saul Griffith SM '01, PhD '04, and MIT Energy Initiative Director Ernest Moniz. The event was sponsored by the new X-Prize Lab@MIT, a collaboration headed by Erika Wagner of Aero-Astro.



Protection built to scale

Primitive 'dinosaur eel' could inspire future body armor

PHOTO / DONNA COVENEY
Polypterus senegalus

Greg Frost
News Office

Scientists seeking to protect the soldier of the future can learn a lot from a relic of the past, according to an MIT study of a primitive fish that could point to more-effective ways of designing human body armor.

The creature in question is *Polypterus senegalus*, a fish whose family tree can be traced back 96 million years and who still inhabits muddy, freshwater pools in Africa. Unlike the vast majority of fish today, *P. senegalus* sports a full-body armored "suit" that most fish would have had millions of years ago — a throwback that helps explain why it is nicknamed the "dinosaur eel."

It was known that the fish's individual armored scales were comprised of multiple material layers — each of them about 100 millionths of a meter thick. But in a U.S. Army-funded study carried out through the MIT Institute for Soldier Nanotechnologies and featured as the September cover story of the journal *Nature Materials*, a team of

MIT engineers unraveled exactly how the layers complement one another to protect the soft tissues inside the fish body — particularly from a penetrating biting attack. *P. senegalus* is known to be territorial and attack members of its own species that are of similar or smaller size.

Specifically, the team used nanotechnological methods to measure the material properties through the thickness of one individual fish scale — about 500 millionths of a meter thick — and its four different layer materials. The different materials, the geometry and thickness of each layer, the sequence of the layers and the junctions between layers all contribute to an efficient design that helps the fish survive a penetrating attack such as a bite.

This research will help to better understand the relationship between a specific threat and the corresponding design of a protective armor, the team said.

"Such fundamental knowledge holds great potential for the development of improved biologically inspired structural materials, for example soldier, first-responder and military vehicle armor applications," said lead author

Christine Ortiz, an associate professor in MIT's Department of Materials Science and Engineering.

"Many of the design principles we describe — durable interfaces and energy-dissipating mechanisms, for instance — may be translatable to human armor systems," she said.

One way in which the researchers tested the fish armor was by experimentally mimicking a biting attack on top of an individual scale that had been surgically removed from a living fish. The team found that the design of the *P. senegalus* armor kept the crack localized by forcing it to run in a circle around the penetration site, rather than spreading through the entire scale and leading to catastrophic failure, like many ceramic materials.

This study was carried out in collaboration with co-author Professor Mary Boyce, chair of MIT's Department of Mechanical Engineering. The study has two first authors: Benjamin Bruet, a former member of Ortiz's lab who recently received a PhD in materials science and engineering from MIT, and Juha Song, a joint doctoral student between Ortiz and Boyce.



IMAGES / NUO LI

Using a video to confuse the brain, researchers are learning how the brain recognizes visual objects. As the eye scans toward a stuffed beaver (first still, above), the beaver is swapped for a monkey (below). Neurons in the brain begin to confuse the two objects. The confusion demonstrates that time teaches us how to recognize objects. The video is available online at web.mit.edu/newsoffice.



Watch and learn: Time teaches us how to recognize visual objects

Cathryn Delude
McGovern Institute

In work that could aid efforts to develop more brain-like computer vision systems, MIT neuroscientists have tricked the visual brain into confusing one object with another, thereby demonstrating that time teaches us how to recognize objects.

It may sound strange, but human eyes never see the same image twice. An object such as a cat can produce innumerable impressions on the retina, depending on the direction of gaze, angle of view, distance and so forth. Every time our eyes move, the pattern of neural activity changes, yet our perception of the cat remains stable.

"This stability, which is called 'invariance,' is fundamental to our ability to recognize objects — it feels effortless, but it is a central challenge for computational neuroscience," explained James DiCarlo of the McGovern Institute for Brain Research at MIT, the senior author of the new study appearing in the Sept. 12 issue of *Science*. "We want to understand how our brains acquire invariance and how we might incorporate it into computer vision systems."

A possible explanation is suggested by the fact that our eyes tend to move rapidly (about three times per second), whereas physical objects usually change more slowly. Therefore, differing patterns of activity in rapid succession often reflect different images of the same object. Could the brain take advantage of this simple rule of thumb to learn object invariance?

In previous work, DiCarlo and colleagues tested this "temporal contiguity" idea in humans by creating an altered visual world in which the normal rule did not apply. An object would appear in peripheral vision, but as the eyes moved to examine it, the object would be swapped for a different object. Although the subjects did not perceive the change, they soon began to confuse

the two objects, consistent with the temporal contiguity hypothesis.

In the new study, DiCarlo and graduate student Nuo Li sought to understand the brain mechanisms behind this effect. They had monkeys watch a similarly altered world while recording from neurons in the inferior temporal (IT) cortex — a high-level visual brain area where object invariance is thought to arise. IT neurons "prefer" certain objects and respond to them regardless of where they appear within the visual field.

"We first identified an object that an IT neuron preferred, such as a sailboat, and another, less preferred object, maybe a teacup," Li said. "When we presented objects at different locations in the monkeys' peripheral vision, they would naturally move their eyes there. One location was a swap location. If a sailboat appeared there, it suddenly became a teacup by the time the eyes moved there. But a sailboat appearing in other locations remained unchanged."

After the monkeys spent time in this altered world, their IT neurons became confused, just like the previous human subjects. The sailboat neuron, for example, still preferred sailboats at all locations — except at the swap location, where it learned to prefer teacups. The longer the manipulation, the greater the confusion, exactly as predicted by the temporal contiguity hypothesis.

Importantly, just as human infants can learn to see without adult supervision, the monkeys received no feedback from the researchers. Instead, the changes in their brain occurred spontaneously as the monkeys looked freely around the computer screen.

"We were surprised by the strength of this neuronal learning, especially after only one or two hours of exposure," DiCarlo said. "Even in adulthood, it seems that the object-recognition system is constantly being retrained by natural experience. Considering that a person makes about 100 million eye movements per year, this mechanism could be fundamental to how we recognize objects so easily."

The team is now testing this idea further using computer vision systems viewing real-world videos.

This work was funded by the NIH, the McKnight Endowment Fund for Neuroscience and a gift from Marjorie and Gerald Burnett.

MIT awaits data from world's biggest physics experiment

Underground collider comes to life in Europe

Anne Trafton
News Office

Dozens of MIT physicists are waiting anxiously to sift through data from the world's biggest physics experiment, which officially started last week when scientists sent the first beam of protons zooming at nearly the speed of light around the 17-mile Large Hadron Collider near Geneva, Switzerland.

Some 40 MIT researchers are among the thousands of physicists from around the world collaborating on the LHC, the world's most powerful particle accelerator. MIT has the largest American university group working on one of the collider's four detectors, known as the CMS (compact muon solenoid) detector, and a smaller group working on another LHC detector known as ATLAS (a toroidal LHC apparatus).

The first circulating beam is a major accomplishment on the way to the ultimate goal: high-energy beams colliding in the centers of the LHC's particle detectors. Scientists participating in these experiments will analyze these collisions in search of extraordinary discoveries about the nature of the physical universe. Beyond revealing a new world of unknown particles, the LHC experiments could explain why those particles exist and behave as they do. They could reveal the origins of mass, shed light on dark matter, uncover hidden symmetries of the universe, and possibly find extra dimensions of space.

"The start of the LHC culminates about



20 years of design and construction work. The accelerator and the experiments are ready to go. We expect LHC data to arrive on MIT campus very shortly," says Professor Bolek Wyslouch of CMS. "We hope to see new particles and new processes that may explain probably the most fundamental properties of matter."

For physicists, the excitement about the first beam event is unparalleled. "For much of my career, starting in the early 70s, the Standard Model of high-energy physics has worked marvelously well but some of its foundations still remained untested," says MIT physicist Frank Taylor, the U.S. ATLAS muon project leader. "Theoretical physicists have been very creative over the last three and a half decades with many beautiful ideas, which are mathematically consistent but may not represent nature. Now we have an instrument to check these theories and perhaps to find something not even dreamed of. We're very excited!"

Added Professor Steven Nahn, another member of the CMS team, "The LHC represents the first opportunity in a long time to both close the chapter on the prevailing model of how our world works on the most fundamental levels, and, at the same time, perhaps start a whole new chapter. I feel like I'm Vasco de Balboa seeing the Pacific for the first time — a whole new ocean out there — not sure how big it is or what it contains, but it is certainly worth exploring."

Other MIT members of the CMS team are Associate Professors Christoph Paus and Gunther Roland, Professor Wit Busza and senior research scientist George Stephans.

The LHC is operated by the European Organization for Nuclear Research (CERN). The accelerator is located on the outskirts of Geneva near the French border, lying below farmland at depths ranging from 60 to 120 meters.



PHOTOS COURTESY OF CERN

A ceremony is held as the last of 1,746 superconducting magnets is lowered into the 27-kilometer circumference tunnel that houses the LHC.

QUANTUM: Odd effect may spawn new applications

Continued from Page 1

used, because there would be so much less infrared light needed to provide the illumination.

Theoretically, such a system could be used to allow medical diagnostic systems such as CT scans to work with a vastly reduced X-ray output, thereby making them much safer for the patient, but such applications would be much further in the future. It could also someday be used

for safer microscope imaging of living organisms.

Entanglement is a strange property that was deduced theoretically on the basis of the laws of quantum physics, and has been demonstrated over the last several years in a variety of laboratory experiments. Under certain circumstances, when an atom gives off two photons of light at the same time, the two are "entangled" even as they go off in different directions, so that anything

that changes one of the photons simultaneously changes the other as well.

This odd property makes it possible to perform seemingly impossible feats such as "quantum teleportation," in which all of the properties of one subatomic particle are recreated in a different particle some distance away. It has also been demonstrated as a way of producing seemingly foolproof encryption systems for data transmission. But explanations of exactly



MIT engineers work toward cell-sized batteries

Forget 9-volts, AAs, AAAs or D batteries: The energy for tomorrow's miniature electronic devices could come from tiny microbatteries about half the size of a human cell and built with viruses.

MIT engineers have developed a way to at once create and install such microbatteries — which could one day power a range of miniature devices, from labs-on-a-chip to implantable medical sensors — by stamping them onto a variety of surfaces.

In the Proceedings of the National Academy of Sciences (PNAS) the week of Aug. 18, the team describes assembling and successfully testing two of the three key components of a battery. A complete battery is on its way.

"To our knowledge, this is the first instance in which microcontact printing has been used to fabricate and position microbattery electrodes and the first use of virus-based assembly in such a process," wrote MIT professors Paula T. Hammond, Angela M. Belcher, Yet-Ming Chiang and colleagues.

MIT researchers see alternative to common colorectal cancer drug

A compound that accumulates in cells more readily than a commonly used colorectal cancer drug may be just as useful in treating colorectal tumors, but with fewer side effects, MIT researchers have found.

Both compounds are analogues of cisplatin, a potent anticancer agent, but the newly investigated compound, known as cDPCP, may better target colorectal cells, potentially sparing other body tissues from damage.

"This compound, the antitumor properties of which were established in mice over 20 years ago, emerged in our search for platinum anticancer drug candidates with cellular uptake properties analogous or superior to those of oxaliplatin," said Stephen Lippard, the Arthur Amos Noyes Professor of Chemistry and a member of the David H. Koch Institute for Integrative Cancer Research at MIT.

Gold goes beyond jewelry

The glitter of gold may hold more than just beauty, or so says a team of MIT researchers that is working on ways to use tiny gold rods to fight cancer, deliver drugs and more.

But before gold nanorods can live up to their potential, scientists must figure out how to overcome one major difficulty: The surfaces of the tiny particles are coated with an uncooperative molecule that prevents researchers from creating perfect nanorods.

"The surface chemistry is really key to everything," said Kimberly Hamad-Schifferli, assistant professor of biological and mechanical engineering at MIT. "For all of these nifty applications to work, someone's got to sit down and do the dirty work of understanding the surface."

what underlies the entanglement phenomenon remain controversial.

Lloyd says that he cannot provide a simple, intuitive explanation for why the quantum illumination system described in this report actually works, but is certain that the theoretical calculations demonstrating it are correct. "It is as if the two entangled photons retain a memory of each other long after any such memory should have faded away," he said.

MIT to Congress: Spark 'energy revolution' with boost in R&D funding

Hockfield delivers message of urgency on Capitol Hill

David Chandler
News Office

MIT President Susan Hockfield urged Congress to sharply increase federal funding for energy research during testimony on Sept. 10, saying such a move could help unleash an "energy revolution" capable of resolving several of America's problems at once.

"We stand on the verge of a global energy technology revolution," Hockfield said in testimony before the House Select Committee on Energy Independence and Global Warming in Washington last week. "The question before us is: Will America lead it and reap the rewards? Or will we surrender that advantage to other countries with clearer vision?"

At the hearing, titled "Investing in the future: R&D needs to meet America's energy and climate challenges," Hockfield said boosting federal energy research could simultaneously help address the problems of a shaky economy, geopolitical instabilities linked to energy consumption and security, and the growing evidence of climate change.

"If one advance could transform America's prospects," she said, "it would be having a range of clean, renewable, low-carbon energy technologies, ready to power our cars, our buildings and our industries, at scale, while creating jobs and protecting the planet." Toward that end, the MIT Energy Initiative, in addition to a range of important scientific and engineering advances, has already generated landmark reports on nuclear, geothermal and coal technologies, and has additional reports in the works on solar power, cap-and-trade policy and other energy approaches.

Chaired by Massachusetts Congressman Edward Markey, the House Select Committee on Energy Independence and Global Warming was created last year to address issues related to the urgent challenges of oil dependence and climate change. In addition to Hockfield, the committee heard testimony from Stephen Forrest, vice president of research at the University of Michigan; Jack Fellows, vice president of the University Corporation for Atmospheric Research; and Daniel Kammen, professor at UC-Berkeley.

While federal funding for energy research has helped power the economy in the past, Hockfield noted, it has dwindled alarmingly in recent years, from 10 percent of the federal research budget in 1980 to just 2 percent today. At the same time, corporate R&D by energy companies has also plummeted, she said, to less than one-quarter of 1 percent of revenues, compared to the 18 percent invested by pharmaceutical companies.

"Congress funded the basic research that spawned the information technology revolution and the biotech revolution," she said. "Today, to spark an energy revolution, Congress must lead again."

Hockfield pointed out that at the beginning of World War II, former MIT Dean of Engineering and Vice President Vannevar Bush persuaded President Franklin D. Roosevelt to make major investments in R&D, which resulted in innovations that not only helped to win the war but also spurred an ongoing partnership between the government and universities that "launched many of our most important industries, produced countless medical



PHOTO COURTESY OF THE HOUSE SELECT COMMITTEE ON ENERGY INDEPENDENCE AND GLOBAL WARMING

MIT President Susan Hockfield sits with three other witnesses during testimony in front of the House Select Committee on Energy Independence and Global Warming on Sept. 10. Hockfield urged the federal government to increase the research and development budget for the study of energy.

advances and spawned virtually all of the technologies that define our modern quality of life."

There is great potential for a similar impact today, she said.

Hockfield was asked for her impression of how much interest there was among students in working on such energy technologies. "The students' interest level is absolutely deafening," she said. "Students are wildly enthusiastic." As an example, she pointed to work done by the student-led MIT Energy Club, with its more than 700 members.

To take the lead in developing the new energy technologies the world needs, Hockfield said, the United States should triple its investment in energy research promptly, then move to a higher level as the Department of Energy builds its capacity to translate basic research to the marketplace. She called for industry, government and universities to work together on a collaborative "road map" to

plan those next steps for coming years. And she emphasized the importance of spreading that research money broadly across a portfolio of energy research areas, not just those that seem poised for the most immediate return.

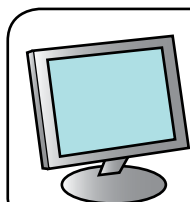
"We can't choose winners now, we don't know what they will be," she said.

The first step, she suggested, is to

set up the collaborative panel to create a detailed strategic plan for the coming years.

"We need work going on across a range of technologies," Hockfield said. "We need to develop everything we can get our hands on." By doing so, she said, "we can turn this global energy challenge into a global opportunity."

Hockfield will speak on energy again this week in Washington, at a press conference today at the National Press Club, which will also feature two energy industry leaders and the director of a national laboratory. The event will highlight the importance of federally funded R&D to the nation's commercial competitiveness.



To read Susan Hockfield's opinion piece, which ran in the Washington Post, please visit the news office web site at web.mit.edu/newsoffice

On Capitol Hill, Deutch stresses all-out energy approach

Calls for carbon tax, efficiency improvements and new agencies

David Chandler
News Office

MIT Institute Professor John Deutch stressed the importance of pursuing every available avenue on energy, in testimony on Sept. 12 before the U.S. Senate's Committee on Energy and Natural Resources.

Deutch, who has served in major roles in several administrations including director of energy research under President Carter and undersecretary and deputy secretary of defense as well as director of central intelligence under President Clinton, said, "The fact is that the United States has not been, and is not now, on a path to a secure and sustainable energy future." The nation's overall importation and consumption of fossil fuels is projected to go on increasing, he said.

While there are several factors that have prevented the adoption of a sustained national energy policy, he said, the key cause is that "political leaders find it difficult to speak the truth about energy matters." The reality, he said, is that progress will be slow because of the magnitude of the problems.

Deutch offered seven recommendations and emphasized that these represent not a menu of choices, but a package of actions that are all essential in order to reach a sustainable future.

First, he said, charging for greenhouse gas emissions is essential, whether in the form of a direct carbon tax or a cap-and-trade system. Second, a major 10-year program to demonstrate carbon sequestration is essential to make clean coal a reality. Third, a push is needed to improve the efficiency of energy use in buildings, cars, and appliances.

Fourth, much more research is needed on potential energy solutions. This requires at least a doubling of federal research funding, the creation of a new energy innovation council to develop a multiyear research strategy across all government agencies, and an energy technology corporation to manage demonstration projects, he said.

Fifth, there should be an expansion of domestic oil and gas production, which he said is important to add credibility to U.S. efforts to encourage other nations to increase their production. Sixth, commercial nuclear power should be expanded, although this requires addressing issues of cost, waste management, and nuclear weapons proliferation.

Finally, Deutch said, there must be improvements in the coordination of energy policy across multiple government agencies, by creating an energy coordinating council.

Deutch rejected calls for an energy research program akin to the Apollo program or Manhattan Project. Unlike those focused government programs with very specific, clearly defined objectives, he said, "Here, we're talking about having a technology deployed in the real economy, and the issues are much more complex."

After a question and answer period during which each of the 20 senators on the committee expressed their views, Deutch said, "I'm impressed that all of you are saying that we need to do 'all of the above' — that is, that every possible alternative should be aggressively pursued, as he recommended. Given that support, he then asked, why isn't it happening?"



Lecture examines anti-evolution movement

Mandana Sassanfar
Department of Biology

In an early kickoff to the 200th anniversary celebration of English naturalist Charles Darwin's birth, members of the MIT community gathered Wednesday, Sept. 10, to hear an expert offer a historical perspective on the movement against the teaching of evolution.

Louise Mead of the National Center for Science Education, founded to defend and promote the teaching of evolution in public schools, traced the morphing of creationism to creation science to intelligent design, and finally to the current "teach the controversy" campaign.

"There is no scientific controversy about evolution," Mead told a packed audience at the Whitehead Institute's McGovern Auditorium, adding that scientists "need to do a better job educating people about evolution."

Darwin was born Feb. 12, 1809. His detailed observations of animal and plant species provided him with the evidence to support his theory of the existence of common ancestors, with natural selection as a mechanism of evolution.

The event was organized by biology graduate students Emiko Fire, Sarah Bagby, Brian Chin, and Matt Wohlever, and Professor of Molecular Biology Jonathan King.

After her presentation, Mead answered many questions from the audience, and heard suggestions and comments about promoting the teaching of evolution in public schools while being sensitive to religious faith and how to diminish the current clash between science and religion.

Some in the audience agreed with a need to compromise and teach evolution while also mentioning intelligent design in public school, others wondered if discussion of intelligent design in science classes would legitimize its theory, while one member of the audience wondered how much the general public trusted scientists and therefore scientific evidence that supports the theory of evolution. Another member of the audience likened the teaching of creationism in schools to an assault on the minds of children.

MIT will celebrate Darwin's anniversary Jan. 22-24 with the Darwin Bicentennial Symposium.

Kennedy's Portable Light wins Tech Award

A groundbreaking renewable energy project directed by Sheila Kennedy, professor of the practice of architecture at MIT and principal of KVA MATx in Boston, has won an international award for technology that benefits humanity.

The Portable Light Project, a nonprofit initiative established by Kennedy and MATx, the materials research unit at KVA, was selected as one of 25 laureates of this year's Tech Awards.

The Portable Light Project embeds flexible photovoltaic materials, digital electronics and solid state lighting in textiles, enabling people in the developing world to create and own energy harvesting textile blankets, bags and clothing using local materials and traditional weaving and sewing techniques. In addition to Kennedy, MIT alumni Sloan Kulper '03 and Casey Smith SM '02 have worked on the project since 2004.

"More than two billion people worldwide do not have access to electric power or light," Kennedy said. "Portable Light takes the approach that clean energy technology can be provided in an open-source model that is flexible and adaptable to meet the needs of people in different cultures and global regions. It's a great honor for the Portable Light Project to be recognized as a 2008 Tech Award Laureate as we expand to South Africa, Nicaragua and Brazil."

Established in 2001 by the San Jose, Calif.-based Tech Museum of Innovation, the Tech Awards recognize laureates in five universal categories: education, equality, environment, economic development and health. The Portable Light Project is a laureate in the economic development category; one laureate in each category will receive a \$50,000 cash prize during an awards ceremony Nov. 12.



PHOTO / KVA MATx

Portable Light textiles charge in the sun in a Huichol village in the Tateikie region of the Sierra Madre, Mexico. A Huichol man in the Sierra Madre uses a Portable Light textile to charge his cell phone and place a call to check market prices.

OCW: D'Oliveira takes the helm at MIT's OpenCourseWare

Continued from Page 1

"MIT OCW will continue to lead the open education movement by example, sharing the quality educational resources created by the MIT faculty and showcasing the innovative educational programs at the Institute for a large global audience of students, educators and self-learners," she said.

Having served as technology director for OCW since 2002, d'Oliveira has been responsible for planning and support of the initiative's technical infrastructure, including software, hardware, networks and technical standards used in production and delivery of MIT course materials to users around the world.

Prior to her work with OCW, d'Oliveira co-founded and served as vice president of operations for SupplyWorks, a service provider for Internet-based manufacturing e-procurement. Before that, she spent more than 13 years in a variety of technology

leadership positions at MIT, including director of information technology support and director of distributed computing & network services.

Launched in the spring of 2001 with more than \$30 million in gifts and foundation grants, OCW publishes the educational materials from all MIT undergraduate and graduate courses on the web for worldwide use, free and open to anyone. D'Oliveira noted that OCW is possible because of the voluntary contributions of educational materials from MIT faculty, teaching staff and students; every week, new courses and updated course materials are added to the site.

Over the past six years, OCW has become one of MIT's most important global outreach activities, with more than a million visitors each month — more than two million if one includes the affiliated sites around the world that host OCW mirrors and translations.



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Members of the MIT community may submit one ad each issue. Ads should be 30 words maximum; they will be edited. Submit by e-mail to ttads@mit.edu or mail to Classifieds, Rm 11-400. Deadline is noon Wednesday the week before publication.

FOR SALE

2000 Citation 37 ft. trailer w/2-bedrooms (never been on the road). Located at Chewonk campgrounds in Maine. Asking \$14,500 or best offer. Please call Joe at 978-664-4414.

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MISCELLANEOUS

Looking for something fun to do? Enjoy playing foosball? Come check out Big City Foosball at 138 Brighton Ave, Allston. Tournaments and leagues Sundays, Mondays, Tuesdays. www.massfoos.com or email bostonfoosball@gmail.com.

MIT CHINA FORUM



Tuesday, September 23, 2008

MIT Stata Center
Room 32-123/Kirsch Auditorium
32 Vassar Street
Cambridge, MA

5:45–7:00pm R&D and Manufacturing in China: Lessons Learned

Panelists:

Victor Cheng, President of Delta Networks, Inc.
Paul Hsu, President of the Epoch Foundation and chairman/CEO of PHYCOS International
Barry Lam, Chairman of Quanta Computer, Inc.

Moderator:

Prof. Yasheng Huang, MIT Sloan School of Management

Taiwan is the largest investor in China, especially in information technology. Today, much of IT equipment - laptops, cell phone, Wi-Fi access points, etc., is made by Taiwan, in China. Taiwan-based companies such as Delta, Foxconn, Quanta, are extremely successful in China. In this panel discussion, Taiwanese business and industry leaders will share with us what has worked and what has not, what this means for China and for Taiwan, and to speculate on the future.



Sponsored by the Office of the Associate Provost

Tales from the crib

MIT assistant publishes her 20th children's book



IMAGES COURTESY OF SALLY LEE
Pages from one of Sally Lee's children's books, "The Tutu Ballet."



PHOTO / PATRICK GILLOOLY
Sally Lee, an administrative assistant in the Computer Science and Artificial Intelligence Laboratory, poses with one of her children's books and one of her paintings, which can be found hanging throughout the Stata Center.

Anne Trafton
News Office

MIT is home to many published authors, but Sally Lee may be the only one whose target audience is under 6 years old.

Lee, an administrative assistant in CSAIL, has just published her 20th children's book, "The Tutu Ballet." Her self-published books, which are available on her web site and on Amazon.com, focus on the importance of accepting yourself and others.

"I'm kind of a kid myself. I'm trying to write books that appeal to kids and not necessarily offer a moral lesson, although they do have a little bit of that," Lee says.

Lee, who started writing and illustrating children's books about five years ago, said she never intended to write so many. After finishing a book, "I always say, 'This is it, I'm not doing another one,' and then I get a new idea," she says.

Though she's relatively new to writing books, Lee has been painting and drawing her whole life. She didn't plan to pursue art as a career, but one of her college professors encouraged her to do so. She painted for a while and did several gallery shows, but found she didn't enjoy it as much as she thought she would.

"Painting is very isolating," she says. "It's kind of a lonely business."

She did her first children's book with her mother, then decided to keep it on her own. When she first started, she tried to get a traditional publisher to produce her books, with no luck. Then she discovered Book-Surge, a company that allows authors to self-publish books through the Internet.

Inspiration for "The Tutu Ballet" came after Lee saw a children's ballet class at the YMCA. A couple of the girls, about 3 years old, were wander-

ing around in circles, having fun and not really paying attention to the teacher.

She ended up writing a book about a ballet class in which each student only wants to practice a particular position. The teacher gets frustrated, until she decides that the best thing to do is to create a dance routine that takes advantage of each student's strengths.

"It's a story about tolerance and adapting but still having a good final result that makes everybody happy," Lee says. "I wanted to stress the joy of doing something with your friends, as opposed to doing it completely perfectly."

Lee, who is deaf in one ear, has also written a 10-book series on a rabbit named Lucy who has the same handicap.

Though her books aren't sold in bookstores, they can be bought on Amazon.com, where dozens of customers have posted positive reviews.

Her colleagues in CSAIL have also been very supportive of her work, she says, and about 20 of her paintings hang in various locations around the Stata Center, including her group's office and CSAIL headquarters.

"Sally livens up the eighth floor, treating us all to sweets and stories, and bringing out the 6-year-old in both students and faculty," said Manolis

Kellis, associate professor of computer science and electrical engineering, whose office is in Lee's group. "Her children's books are relevant, by their simplicity and timelessness, to much beyond her target age group."

Lee, who has been at MIT for 14 years, says she enjoys working in an academic environment because "it allows me to be around a lot of different people and also pursue my own talent, and they are very supportive of that."

For more information on Lee's books, visit www.leepublishing.net.

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Sally livens up the eighth floor, treating us all to sweets and stories, and bringing out the 6-year-old in both students and faculty.

Manolis Kellis
associate professor of computer science