

Energy

The nitty-gritty of energy

New physics course may be first of its kind nationwide

David Chandler
News Office

College courses focused on energy have been proliferating widely in recent years, at MIT and elsewhere. But one new class here approaches the subject in a very different way.

Energy has typically been taught from the perspective of mechanical or electrical engineering, materials science, chemistry, or even biology. But MIT's new "Physics of Energy" (8.21) tackles the subject in terms of the basic underlying mechanisms involved, and both the promise and the limitations that are inherent in energy alternatives based on known physical principles.

"The laws of thermodynamics, and basic physics, draw lines around what you can and can't do" in terms of harnessing various sources of energy, says Robert L. Jaffe, the Otto (1939) and Jane Morningstar Professor of Science in the Department of

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Krugman, formerly of MIT, wins Nobel economics prize

Elizabeth Thomson
News Office

Former MIT economics professor Paul R. Krugman PhD '77 won the Nobel economics prize for "his analysis of trade patterns and location of economic activity."

In announcing the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel on Oct. 13, the Royal Swedish Academy of Sciences said Krugman had formulated a new theory to address the effects of free trade and globalization and the driving forces behind worldwide urbanization. In doing so, he integrated previously disparate research fields of international trade and economic geography.

Krugman, 55, has a long history with MIT. After graduating from the Institute, he was an assistant professor at Yale for three years before returning to MIT as

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CELEBRATING A LIFE

Institute, friends and family gather to remember Alexander d'Arbeloff, 1927-2008

Greg Frost
News Office

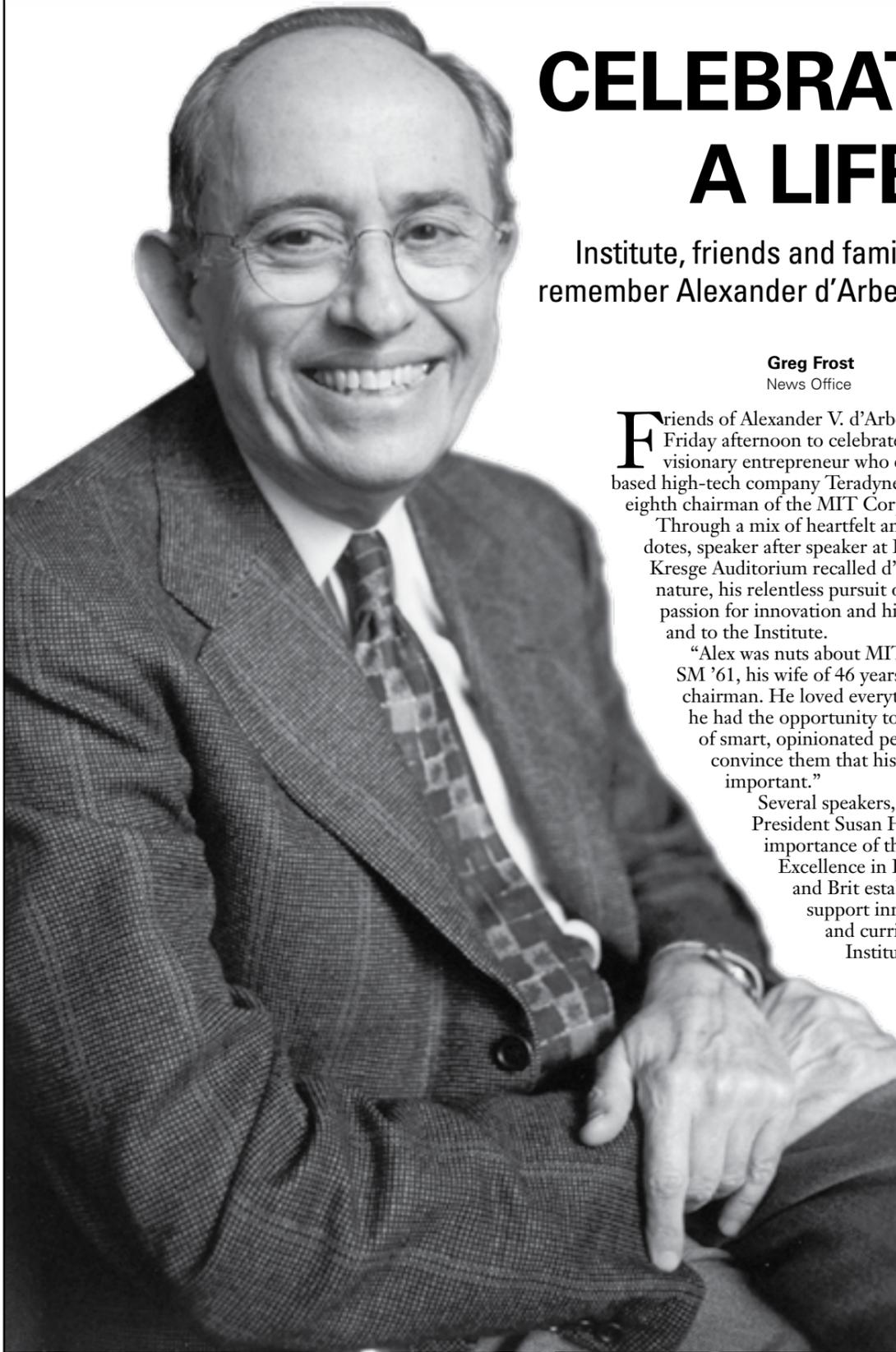
Friends of Alexander V. d'Arbeloff '49 gathered Friday afternoon to celebrate the life of the late visionary entrepreneur who co-founded Boston-based high-tech company Teradyne before becoming the eighth chairman of the MIT Corporation.

Through a mix of heartfelt and humorous anecdotes, speaker after speaker at Friday's gathering in Kresge Auditorium recalled d'Arbeloff's dynamic nature, his relentless pursuit of excellence, his passion for innovation and his devotion to family and to the Institute.

"Alex was nuts about MIT," said Brit d'Arbeloff SM '61, his wife of 46 years. "He loved being chairman. He loved everything about it because he had the opportunity to work with a lot of smart, opinionated people and tried to convince them that his ideas were more important."

Several speakers, including MIT President Susan Hockfield, spoke of the importance of the d'Arbeloff Fund for Excellence in Education, which Alex and Brit established in 1999 to support innovations in teaching and curriculum design at the Institute.

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PEOPLE

Institute faculty rack up honors

Several named to AAAS, 'Brilliant 10' and Institute of Medicine. See Awards & Honors.

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RESEARCH

Bridging ideas

Model inspired by bridge engineers applied to cell research; could improve chemotherapy treatments.

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NEWS

MIT 9th in the world

International higher education rankings put the Institute at No. 9 out of 604.

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Events
at MIT

Today

- **“U.S. Nuclear Policy: Critical Choices.”** Speaker: Joseph Cirincione. 5-7 p.m. in 32-123. Join us for a substantive and provocative discussion of U.S. nuclear policy and the critical choices facing a new administration in Washington.
- **“Starr Forum: Health Care Policy and the Next U.S. Administration.”** 6-7:30 p.m. in E25-111. The U.S. health care system is a critical issue in the current presidential campaign, with Barack Obama and John McCain each offering a remedy. But many Americans haven't a clue to what's crippling our system, much less the cure. Join noted health care economist Jonathan Gruber as he diagnoses our ailing health care, explains why other countries' systems are in better shape, and offers a recovery plan — in light of the acute financial crisis — to our next president.
- **Soap Box Series:** “Grassroots and Global: Technologies and Social Change” with Henry Jenkins. 6-8 p.m. in N51, MIT Museum at 265 Massachusetts Ave. Interactive, salon-style talk with Henry Jenkins, Director of the MIT Comparative Media Studies Program on “What is Civic Media?”

• **“U.S. Nuclear Policy: Critical Choices: A Conservative and Progressive View.”** Speakers: Mark Esper and Joseph Cirincione. 4-6 p.m. in 32-141 (Stata Center). What policies would we like to see the new administration follow to reduce the threat of nuclear war and proliferation. And which of these policies can we realistically expect to see happen?

Thursday, Oct. 23

- **Karl Iagnemma** will be reading from his works, “On the Nature of Human Romantic Interaction” and “The Expeditions,” as the Fall 2008 MIT Writers' Series continues. Room 32-141, 7-9 p.m. Iagnemma received the Paris Review Plimpton Prize for his short stories and in 2004 was awarded a fiction grant from the National Endowment for the Arts. Books will be available for signing.
- **“Voting Technology and Election Integrity: National Landscape and Challenges.”** Speaker: Alexander Shvartsman, University of Connecticut. 4-5:30 p.m. in 32-G449.

• **MIT's Systems Thinking conference.** Oct. 23-24. Global industry leaders and MIT faculty will speak on the importance of using a systems approach to solving complex problems, such as sustainability and the environment, product design and technology strategy. URL: <http://sdm.mit.edu/conf08>

Monday, Oct. 27

- **City Design and Development Forum: Landscape + Urbanism.** Speaker: Eran Ben-Joseph, associate professor Landscape Architecture + Planning. 5-6:30 p.m. in 10-485. Subject: “Rethinking a Lot: The Design and Culture of Parking.”

MIT's Smith wins top honors
for work in developing worldPopular Mechanics gives her
Breakthrough Leadership award

As part of its annual roster of Breakthrough Awards for “life-changing innovations,” Popular Mechanics magazine has awarded its top honors to MIT Senior Lecturer Amy B. Smith, creator of the D-Lab classes that foster clever low-tech solutions to pressing problems in developing nations.

Calling Smith “a visionary,” the magazine gave her its Breakthrough Leadership award, the top honor out of the 20 awards in its annual list. The magazine cited her as “an inspiration to students and volunteers who dedicate their time to improve the standard of living in Haiti, Ghana, India and other countries. She is leading a movement to tackle complex problems with simple technology.”

In addition to D-Lab, Smith runs the International Development Design Summit each summer, which brings dozens of people from around the world together for four weeks for intensive brainstorming and prototyping of solutions to local problems from different regions of the developing world. After being held at MIT for the last two years, next summer the summit will take place in Ghana, giving the participants more direct contact with the kinds of communities their inventions are intended to serve.

“It will be interactive in a way we haven't been able to do” at MIT, says Smith, whose work is still sustained in part by a MacArthur Foundation “genius grant” she received four years ago. For participants who come from industrialized countries, she said, the summit in Ghana will enable “people who haven't had a chance to experience life in the developing world” to be immersed in that environment firsthand.

Even for those from other developing nations, she said, it's a chance “for people from Tibet to see what life is like in Ghana,” for example. “People tend to lump the developing world together,” she said, but the problems and potential vary widely from one country to another.

Meanwhile, D-Lab itself continues to grow, having doubled in size over the last year, she says. And it has helped to inspire a variety of other classes and projects that embody Smith's approach of addressing the basic, local needs of people around the world through small-scale engineering with simple tools and readily available materials.

“MIT students are incredibly lucky now,” she says. “If they wanted to be involved in this kind of development work every single semester they're here, they could do that now. That didn't used to be the case.”

The Popular Mechanics awards were presented at a banquet in New York on Oct. 15, with Smith as the keynote speaker.

Awards&Honors



8 MIT faculty named to the AAAS

Eight MIT faculty members were inducted into the American Academy of Arts and Sciences (AAAS) as part of its new class of 190 fellows and 22 foreign honorary members.

The academy welcomed this year's new class at its annual induction ceremony on Oct. 11 at its Cambridge, Mass., headquarters.

New members of the American Academy of Arts and Sciences from MIT are:

- Tobias Colding, professor of mathematics
- Christopher Cummins, professor of chemistry
- Alan D. Grossman, Praecis Professor of Biology
- Timothy L. Grove, professor of geology
- Jonathan Gruber, professor of economics
- Klavs F. Jensen, the Warren K. Lewis Professor and department head of chemical engineering, professor of materials science and engineering
- Marc A. Kastner, dean, School of Science; Donner Professor of Science
- Henry I. Smith, professor of electrical engineering

Two faculty among Popular
Science's 'Brilliant 10'

Popular Science magazine has named MIT faculty members Rebecca Saxe and Francesco Stellacci to its annual “Brilliant 10” list of the country's top young scientists to watch. The list appears in the November issue of the magazine, which hit newsstands Thursday, Oct. 14.

Rebecca Saxe, whom the magazine called “The Infant's Philosopher,” is the Frederick A. and Carole J. Middleton Career Development Assistant Professor of Cognitive Neuroscience. Saxe, 29, received an MIT PhD in 2004.

Stellacci, dubbed “The Materialist” by the magazine, is the Paul M. Cook Career Development Associate Professor of Materials Science and Engineering.

Whitehead director Page named
to the Institute of Medicine

David C. Page, director of the Whitehead Institute, professor of biology at MIT and a Howard Hughes Medical Institute investigator, has been elected to the Institute of Medicine.

He is among 65 new members of the Washington, D.C.-based institute, raising its total active membership to 1,736.

The Institute of Medicine is one of the four national academies, along with the National Academy of Sciences, the National Academy of Engineering and the National Research Council. It serves as a national resource for independent, scientifically informed analysis and recommendations on human health issues.

David
PageDe Neufville's contributions
recognized by TRB

Professor Richard de Neufville, of the Department of Civil and Environmental Engineering and the Engineering Systems Division, will receive the Francis X. McKelvey Award from the Transportation Research Board (TRB), a division of the National Research Council, at its annual meeting in January. The McKelvey Award recognizes individuals whose work has contributed to the betterment of the aviation industry. In this case, it honors de Neufville's lifelong achievements in education, research and consulting in airport planning, design and management.

Doyle wins Pioneers of Miniaturisation prize

Patrick S. Doyle, an associate professor in the Department of Chemical Engineering, was recently awarded the 2008 Pioneers of Miniaturisation prize, given out by the Royal Society of Chemistry through the Lab on a Chip Journal. The \$5,000 award is for young to mid-career scientists for extraordinary or outstanding contributions to the understanding or development of miniaturized systems.

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What happened? What's next?

PHOTO / DONNA COVENEY

An MIT panel comprised of five faculty members got together to discuss the current economic situation with the Institute community at Huntington Hall on Tuesday, Oct. 7.

Tackling the questions of "The U.S. Financial Crisis: What Happened? What's Next?" are, left to right, William Wheaton, director of the Center for Real Estate; Andrew Lo, Harris and Harris Group Professor, MIT Sloan School of Management; Ricardo Caballero, head, MIT Department of Economics; Bengt Holmstrom, professor of economics; and James Poterba, Mitsui Professor and head of the Department of Economics.

Events at MIT



Tuesday, Oct. 28

• **2008 MIT Research and Development Conference.** 8 a.m.-5 p.m. W16-Kresge
URL: <http://ilp-www.mit.edu/events/RD2008>

• **"A Conversation with George Soros: The New Paradigm for Financial Markets"** with Ricardo Caballero, head of MIT's Department of Economics. 3:30 p.m. in Kresge Auditorium.

• **MIT Sloan Dean's Innovative Leader Series.** Speaker: Bob Malone SM '89, chairman and president, BP America. Noon-1 p.m. in E51-Wong Auditorium.

• **A Conversation with Admiral William Fallon.** 4:30-6 p.m. E51-Wong Auditorium. Fallon, CIS Robert E. Wilhelm fellow and former head of CENTCOM addresses global issues of national importance for the next U.S. administration.

Wednesday, Oct. 29

• **"Mathematics of Sea Ice to Help Predict Climate Change."** Speaker: Professor Kenneth M. Golden, Department of Mathematics, University of Utah. 4-5 p.m. in 54-915. Part of the EAPS Department Lecture Series.

• **"Street Songs in Paris, 1749: A Cabaret-Lecture"** with Robert Darton and Helene Delaveau. Killian Hall, with a reception to follow.

• **Pumpkin Carving.** 9-10:30 p.m. W84-24th floor. Pumpkin carving is a popular event in Tang every year near Halloween. Pumpkins, carving tools, patterns, and a brief lesson are provided. Interested residents enter a final contest where a prize is awarded.

Thursday, Oct. 30

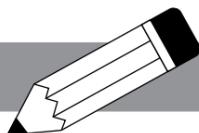
• **MIT Writers Series: Courtney Humphries '04.** 7-8 p.m. in 32-141. Reading from her book, "Superdove: How the Pigeon Took Manhattan ... and the World."

• **Center for 21st Century Energy Fall 2008 Seminar Series.** Speaker: Amir Maria on "The Role of Fuel in Determining the High Load Limit of HCCI Engines." 4-5 p.m. in 37-212.

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



MIT ninth among world's universities

MIT ranks ninth among 604 universities from around the world included in the 2008 Times Higher Education-Quacquarelli Symonds World University Rankings released recently.

In specific academic categories, the Institute ranks first in both "engineering and IT" and in "natural sciences." It is eighth in "life sciences and biomedicine," 10th in "social sciences," and 20th in "arts and humanities." Further, MIT ranked fifth overall according to survey responses from 6,354 academics, and sixth overall according to 2,339 employers.

In the overall university rankings, Harvard is the top university, followed by Yale and the University of Cambridge.

This year's rankings "reflect the increasing profile of technology-based universities, with many of the world's top universities in this area such as Caltech, MIT, ETH Zurich and Hong Kong University of Science and Technology improving their position," according to the Times Higher Education (THE) and Quacquarelli Symonds (QS). "As demand by international employers for more technology-literate graduates has grown, the importance of these universities has risen in the rankings." Last year MIT was ranked 10th overall.

The THE-QS rankings are now in their fifth year. For more information on the rankings and the methodology behind them, go to www.topuniversities.com.

Students invited to apply for \$30K Lemelson-MIT student prize

The Lemelson-MIT Program invites MIT graduate students and graduating seniors who have created or improved a product or process, applied a technology in a new way, or redesigned a system to apply for the \$30,000 Lemelson-MIT Student Prize for inventiveness. The application deadline is Wednesday, Dec. 10.

Interested students need to complete an online application available at <http://mit.edu/invent/a-student.html>, which includes a description of his or her inventiveness while at MIT, two letters of recommendation and a current resume or CV. Students must review the details about eligibility and criteria before they begin the process. Questions may be directed to the Lemelson-MIT program officer at lemelson_awards@mit.edu.

The winner will be announced at a press conference in February 2009.

Community Giving at MIT hosts used book fair Oct. 27

Community Giving at MIT will kick off this year's effort with a used book fair from 9 a.m.-5 p.m. on Monday, Oct. 27, in

Lobby 10 and in the Bush Room, 10-105. Please drop off your gently used or new books by Friday, Oct. 24, at the following locations: Information Center, Public Service Center, Copy Tech, Community Services Office and the MIT Sloan School of Management.

You can also drop books off Oct. 27 in the Bush Room. Proceeds from sales will benefit the MIT Community Service Fund and United Way of Massachusetts Bay and Merrimack Valley. For more info, please visit web.mit.edu/community-giving.

Department of Urban Studies and Planning welcomes 17 new international fellows



SPURS/Humphrey fellows, faculty and staff.

The Department of Urban Studies and Planning at MIT recently welcomed 17 fellows as part of the Special Program for Urban and Regional Studies (SPURS), a one-year program designed for mid-career professionals from newly industrializing countries.

Eleven of the new fellows were accepted through the Hubert H. Humphrey Fellowship Program, an exchange program initiated by the U.S. Congress in 1978 to honor the memory and accomplishments of the late senator and vice president Hubert H. Humphrey. MIT is a host university for Humphrey fellows, through SPURS.

This year's participants come from Afghanistan, Bosnia and Herzegovina, Estonia, Kosovo, Benin, Uganda, Zambia, Ghana, Turkey, Brazil, Colombia, Korea, China and Canada. The fellows come from both public and private sectors of developing countries around the world and are selected through a highly competitive international selection process for their commitment to, and experience in, fields such as city management, economic development, urban and regional planning, physical infrastructure planning, information technology policy and management, and law and human rights.

As part of their contribution to the MIT community, the fellows are connected to MIT undergraduate and graduate students, most recently through International House (iHouse). Fellows mentor iHouse students, who benefit from their practice-oriented experience and learn about internship opportunities in the fellows' countries.

For further information on the program

and the current fellows, please visit: <http://web.mit.edu/spurs/www/>.

Recent retirees honored at dinner



PHOTO / TRACI SWARTZ

Mircea D. Gheorghiu (Department of Chemistry) with Ana Racoveanu at the recent new retirees' dinner.

At a dinner in September, Vice President for Institute Affairs and Secretary of the Corporation Kirk D. Kolenbrander and Vice President for Human Resources Alison Alden presented certificates of appreciation to recent MIT retirees. In their remarks, Kolenbrander and Alden spoke about adventures of working at MIT and the retirees' varied interests, plans for the future and dedicated long-term service — with this year's class of 99 retirees spending a combined 2,729 years at the Institute.

Also participating in the celebration were Bob Blake and Jane Griffin, co-chairs of the Association of MIT Retirees. For more information about the Association of MIT Retirees and its activities, e-mail retirees.assoc@mit.edu or call 617-253-7910.

CBI hosting Oct. 23 roundtable on drug safety

The Center for Biomedical Innovation at MIT will host a roundtable discussion, "Improving Drug Safety: Critical Elements of a Learning Healthcare System," at 2 p.m. Oct. 23 at the Royal Sonesta Hotel in Cambridge. The event is free and open to the public.

Presented in collaboration with MIT's Engineering Systems Division and the New England Healthcare Institute, participants in the discussion include Dr. Mark McClellan, director of the Engelberg Center for Health Care Reform at the Brookings Institution, and Dr. Glen Forbes, CEO of the Mayo Clinic's Rochester Campus, as well as MIT faculty members Richard Larson, Nancy Leveson and Debbie Nightingale.

The discussion will be moderated by Dr. Garry Neil, Corporate Vice President, Corporate Office of Science and Technology at Johnson & Johnson.

To RSVP, e-mail mfrankel@mit.edu or call 617-253-0902.

Shultz urges cut in U.S. oil dependence

David Chandler
News Office

Former U.S. Secretary of State George P. Shultz PhD '49, who has also served as president of Bechtel Group and taught at MIT and Stanford, has witnessed the issues surrounding energy policy from the perspectives of academia, industry and government. And he says that now, after several failed attempts to reduce our oil dependence, we really have to get it right.

Shultz, the chairman of the MIT Energy Initiative's External Advisory Board, spoke about his views on the future of energy in a talk on Oct. 15 in lecture hall 10-250. He pointed out that over the last four decades, there have been four major spikes in oil prices, and each time there was a flurry of activity, proposals and initiatives to address the problem — and each time those initiatives were soon

abandoned. "This time," he said, "we have to get it right, we have to stay with it, no matter what happens to the price of oil."

In the 1950s, Shultz said, President Dwight Eisenhower warned that the nation would be headed for a crisis if it were to import more than 20 percent of its oil needs. "We're at 60 percent now," Shultz noted.

When it comes to people's understanding of the crisis in energy, Shultz said it reminded him of a story about an old Maine farmer reacting to an MIT professor, saying, "He knows everything, but he don't realize nothin'." That's where things stand with energy, he said: "There are things we know, but somehow we don't realize."

Nevertheless, he said, "Today is different. It may well be we have a right to be optimistic this time." A number of factors — including the economic pressures from

high energy prices, the need to address climate change and concerns about national security — "are all pointing in the same direction," toward reducing our dependence on oil.

And there are a lot of specific opportunities available for doing that now, he said. First, providing a stable, predictable set of tax incentives for solar and wind power, rather than the year-by-year approach that has been typical so far; Congress has taken a step in this direction, he said, recently passing an eight-year investment tax credit for such projects.

The top priority, he said, is for the nation to invest much more heavily than it does now in basic research on energy. "If we're going to be subsidizing something, that's what we ought to be subsidizing ... we need to be willing to do it on a sustained basis."



PHOTO / DONNA COVENEY

George Shultz PhD '49, former secretary of state and MIT faculty member, speaks at the Energy Advisory Board meeting on Oct. 15.

Young planets stay hotter longer

Study shows newborn Earth-like planets could be easier to find

David Chandler
News Office

Young planets around other stars may be easier to spot because they stay hotter way longer than astronomers have thought, according to new work by MIT planetary scientist Linda Elkins-Tanton.

For a few million years after their initial formation, planets like Earth may maintain a hot surface of molten rock that would glow brightly enough to make them stand out as they orbit neighboring stars. Elkins-Tanton, Mitsui Career Development Professor of Geology in the Department of Earth, Atmospheric and Planetary Sciences, says the "magma ocean" stage for Earth-sized planets may last a few million years, much longer than previously estimated. "That means we may actually see them elsewhere, as detection systems get better," she said.

She presented her new findings Tuesday, Oct. 14, at the annual meeting of the American Astronomical Society's Division for Planetary Sciences, held this year in Ithaca, N.Y. The research shows that even after the surface magma solidifies, within about five million years, it could stay hot enough to glow brightly in infrared light for tens of millions of years, providing a relatively long window for detectability.

The big problem for astronomers hoping to detect planets around other stars is the vast difference in brightness between the star and the planet, which shines only by reflecting light from its parent star. But the difference in brightness in infrared wavelengths for a glowing, molten planetary surface would be much less, making the detection more feasible.

The long duration of the molten stage turns out to be the result of a two-stage process, Elkins-Tanton explained. The initial heating, generated by a combination of radioactivity in the planet's interior and the heat generated by the collision of millions of chunks of rock crashing together to form the planet, actually is quite short-lived: The planet's surface is expected to solidify quickly, within a few hundred thousand years, as originally thought. But then a secondary upheaval begins, in which heavier iron-rich material that has solidified at the surface begins to sink toward the core, causing other hotter material to rise to the surface.

This "overturn" process, it turns out, produces the much-longer-lived molten surface, lasting for millions of years, she said. Because the Earth's crust is so dynamic, there is no material left from that initial epoch that could be studied to test this modeling, she said, but on other planets such as Mars or Mercury there might be early remnant rocks that could be tested. The analysis also leads to specific conclusions about the surface composition of planets, so detection of certain specific minerals on Mercury, for example, which



PHOTO / DONNA COVENEY

MIT planetary scientist Linda Elkins-Tanton, Mitsui Career Development Professor of Geology in the Department of Earth, Atmospheric and Planetary Sciences, views a profile showing that hot, young planets may be easier to spot because they stay hot longer than astronomers have thought.

the MESSENGER spacecraft may be able to carry out when it begins its study of the planet in 2011, might support the theory.

In addition, the detection of hot, young planets around other stars, which might become possible over the next several years, might provide another line of evidence to support this conclusion, she said.

The research was funded by the National Science Foundation and NASA's Mars Fundamental Research Program.

MIT Museum glows with promise of future energy

Energy Night brings together campus efforts at innovation

More than 1,200 people showed up on Oct. 10 at the MIT Museum to learn about the latest developments, and the most promising new research efforts, in creating new energy technologies and improving the established ones.

Energy Night, organized by the student-run MIT Energy Club and Sloan Energy and Environment Club, showcased more than 40 different projects, clubs and businesses that are pushing the frontiers of research on energy in and around the campus. In addition to posters, displays and demonstrations of energy technologies, the social event featured drinks, hors d'oeuvres and a live jazz band.

"Energy Night was fantastic," said Energy Club co-president Lara Pierpoint. "There was a lot of student excitement, a record number of nuclear-related posters, and the usual great music and food. I know that the Energy Conference team was highly successful in recruiting volunteers and that the electric vehicle team got a lot of attention."

Outside the museum's doors, visitors were treated to inside-and-out views of three electric vehicles: A new fuel-cell car from Honda called FCX Clarity, which is being sold only in California, along with two different versions of custom cars built by the MIT Solar Electric Vehicle team. The team's original solar car has competed in past solar car races, and a newer version is in the process of being finished in preparation for a trans-Australia solar race next year.

Other groups highlighted a range of research projects being carried out now at MIT, including ongoing development of a new type of concentrating solar cell based on coatings that can be applied to existing windows to redirect much of the light to the edges of the glass, where small solar cells can be installed to harness it. Another group is doing research on a proposal, first advanced two years ago by Department of Mechanical Engineering Professor Paul Sclavounos, for developing offshore wind turbines, mounted using technology derived from offshore drilling platforms.

Computer model reveals cells' inner workings

Model inspired by bridge engineers could help improve chemotherapy treatments



Anne Trafton
News Office

After spending years developing a computational model to help illuminate cell signaling pathways, a team of MIT researchers decided to see what would happen if they “broke” the model.

The results, reported in the Oct. 17 issue of the journal *Cell*, reveal new ways in which cells process chemical information and could indicate how to maximize the effectiveness of disease treatments such as chemotherapy.

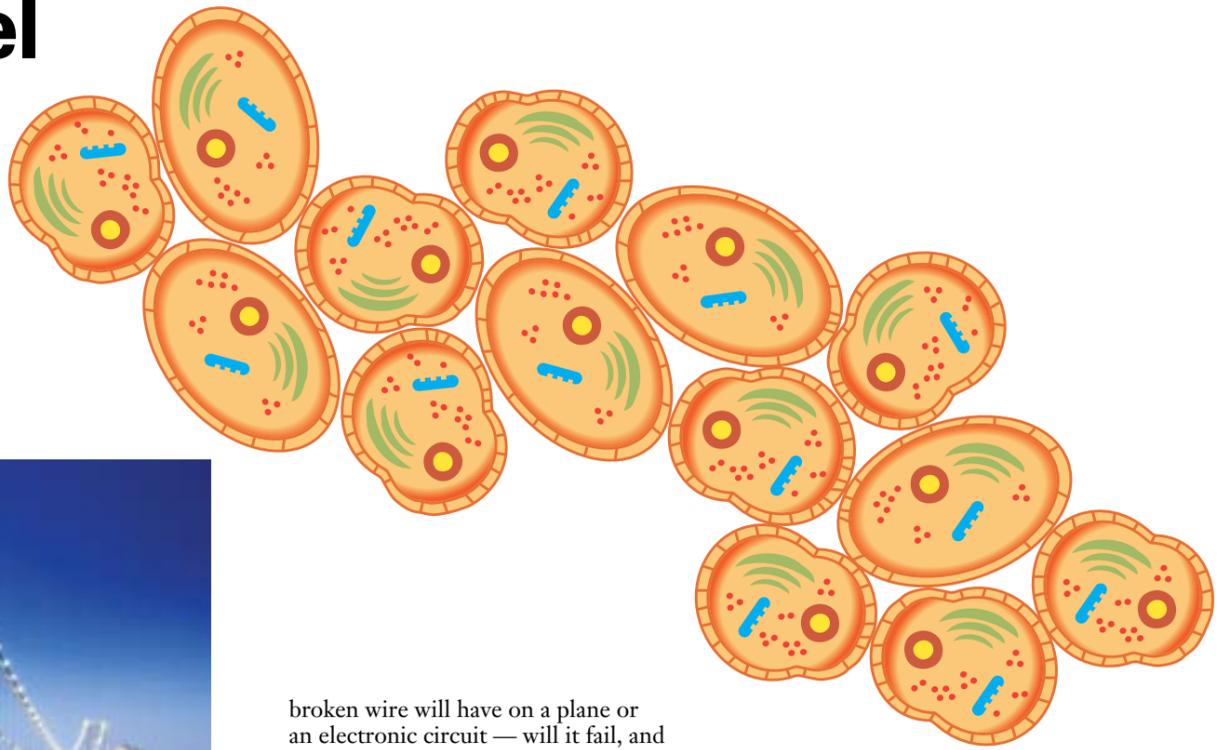
A couple of years ago, MIT faculty member Michael Yaffe and colleagues reported a data-driven computational model that allows them to simultaneously investigate the relationships between several cell signaling pathways, which control the cell's response to inflammation,

growth factors, DNA damage and other events.

Such a model can help researchers figure out how cells will respond to growth factors and treatments such as chemotherapy, allowing them to potentially tailor treatments to individual patients.

In the *Cell* paper, the team took a new approach to wring more information out of their model: They looked at what happens in cells under conditions where the model fails catastrophically. This approach, which the authors call “model breakpoint analysis,” is an extension of more traditional failure analysis methods commonly used by engineers to figure out what design changes would make a bridge fall down or an engine fail.

“In traditional engineering sciences, you frequently use computational methods to predict what effect a faulty strut or a



broken wire will have on a plane or an electronic circuit — will it fail, and if so, when and how?” said Yaffe, associate professor of biology and biological engineering and senior author of the new paper.

Doing the same thing in cellular models can reveal important and previously unexplored aspects of the signaling pathways.

To “break” the computer model, the researchers entered increasingly implausible inputs to the model until it no longer correctly predicted cell fate. To their surprise, they found that the model remained accurate for a long time.

“As the data we used to build the model got progressively worse and worse — more and more biologically inaccurate — the model would work fine, and then when you got to a certain threshold — the breakpoint — the model suddenly wouldn't predict anymore,” said Yaffe, who is affiliated with MIT's David H. Koch Institute for Integrative Cancer Research, the Broad Institute of MIT and Harvard, and Beth Israel Deaconess Medical Center.

“By going back and looking at what happened in the model when the predictions failed, we discovered a surprising amount of new biology that was actually happening in the living cell,” Yaffe said.

One significant, unexpected finding is the observation that both overactive and underactive mutations within a particular gene, such as those found in cancer, reduce cell death compared to the normal gene. This suggests that normal cells are poised

to die whenever there is trouble, but perhaps not tumor cells.

That means the dynamic range of cell signaling — the spread between the highest and lowest levels of a biological signal, like the range of volumes you can hear on your stereo — may be a greater determinant of what cells do than the absolute level of a particular signal, said Yaffe.

The computer modeling approach offers the chance to learn about biological phenomena that might take thousands of hours in the laboratory to uncover, according to Yaffe.

“In addition, rather than looking at one pathway in the cell in isolation, we could look at five pathways or eight pathways simultaneously,” he said. “It also reinforces how engineering ideas can really illuminate biological mechanisms.”

Lead authors of the paper are Kevin Janes, a recent MIT PhD recipient, and H. Christian Reinhardt, a postdoctoral associate in the Koch Institute.

This research was funded by the National Institutes of Health, the Deutsche Forschungsgemeinschaft, the David H. Koch Fund, the Ederly Innovation Fund and the American Cancer Society.

PHYSICS: New course at MIT may be one of a kind in studying how energy works

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Physics, who co-teaches the new class with professor of physics Washington Taylor. The class, offered this fall for the first time, examines these fundamental constraints and aims to give students the tools to carry out such analyses on their own, Taylor and Jaffe say.

In their online description of the course, they point out what really sets this one apart: “You may have heard about courses on the ‘physics of energy’ offered at other universities. The ones we know of are aimed at nonscientists without a background in calculus or calculus-based physics. Because MIT undergraduates are so well prepared in mathematics and physics, we will present material at a considerably more advanced level. This should make the course more exciting (and more challenging).”

At the same time, Taylor says the course is designed to be appropriate for “any undergraduate who has taken freshman physics.” Jaffe adds that the class will have “the kind of intensity usually associated with physics classes.”

MIT Energy Initiative Director Ernest J. Moniz says Jaffe and Taylor's approach is different from typical energy courses in its sophistication in presenting the basic, underlying science.

“As far as we know, it's unlike anything being offered elsewhere, and we hope it will provide a very useful grounding for students seeking a strong foundation in energy science, technology and policy,” says Moniz, the Cecil and Ida Green Distinguished Professor of Physics and Engineering Systems.

The motivation for creating the class, Jaffe says, came from his and Taylor's perception of the kinds of misunder-

standings and misinformation that tend to surround many discussions of energy alternatives — “things that catch your attention as a physicist, sort of like fingernails scraping on a blackboard.”

For example, he says, in talking about the potential of future fusion powerplants, advocates often say the fuel supply is unlimited because there's an “unlimited amount of hydrogen in the ocean.” That's true enough, but no fusion reactor would actually use ordinary hydrogen. “They use tritium,” a relatively unstable radioactive form of hydrogen that is “made by bombarding lithium with neutrons. So that future is dictated by the availability of lithium, and the feasibility of manufacturing fuel in this complex way.”

In this class, “we hope to give people a foundation so they won't be easily deceived,” Jaffe says. They plan to present the basic science and calculations underlying issues such as the relative efficiency of different engine designs, and the effectiveness and potential of technologies

such as solar thermal power and wind power.

The class will spend roughly a third of the semester each on three basic areas: the uses of energy, looking at various kinds of machines and engines and electromagnetic systems; the sources of energy, including fossil fuels, nuclear fission and fusion, and the whole range of renewables — wind, solar, geothermal, hydropower, and so on; and the role of conservation and efficiency.

Two other new courses on energy are being taught here this fall. One is “Fundamentals of Photovoltaics,” a graduate class in mechanical engineering taught by Professor Tonio Buonassisi, the SMA Assistant Professor



Washington Taylor

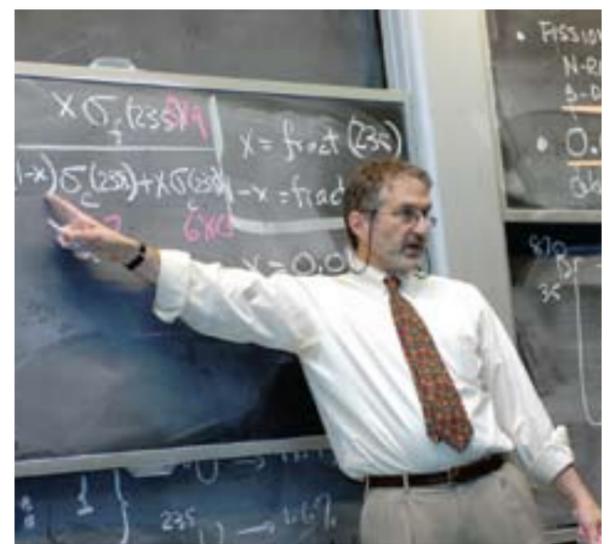


PHOTO / DONNA COVENEY

Robert L. Jaffe, the Otto (1939) and Jane Morningstar Professor of Science in the Department of Physics, teaches the ‘Physics of Energy’ class recently.

of Mechanical Engineering and Manufacturing, which will cover everything from the efficiency of different photovoltaic materials to manufacturing and life-cycle analysis. The other is “Enabling an Energy Efficient Society,” taught by Harvey Michaels, a research scientist in the Department of Urban Studies and Planning.

Awards
& HonorsCEE's Clune receives
top engineering
undergraduate
student award

Graduate student Rory Clune is winner of Britain and Ireland's most prestigious award for science and engineering undergraduates: the GKN Award for the Science, Engineering and Technology Student of the Year.

The GKN Award (named for the British engineering firm) is given to the top student out of 15 winners of Science, Engineering & Technology Student (SET) Awards. Clune won the SET award in the mechanical engineering category — Bentley Motors Award for the Best Mechanical Engineering Student — for his undergraduate work at University College Cork on shape optimization of stainless steel coronary stents.

He and his research advisor, Denis Keliher, who was named Lecturer of the Year, received their awards at a ceremony in London on Sept. 26. Clune began his graduate study in the Department of Civil and Environmental Engineering in September on an MIT Presidential Fellowship.

Transportation alumnus
wins top paper award

Emmanuel Carrier, who earned a PhD in transportation earlier this year, won the Anna Valicek Medal from the Airline Group of the International Federation of Operations Research Societies in September for his paper describing his modeling of the behavior of airline passengers.

The paper is based on Carrier's doctoral research, which models how different categories of airline passengers choose itineraries and fares. For example, for some business travelers, schedule is the most important factor in decision-making; for other business travelers and most leisure travelers, ticket price is more important. Ultimately airlines can use this model to help make decisions for pricing and revenue management.

Moshe Ben-Akiva, the Edmund K. Turner Professor of Civil and Environmental Engineering, and Peter Belobaba, principal research scientist in the Department of Aeronautics and Astronautics, supervised Carrier's thesis research. Carrier now works in Kirkland, Wash., at AI Systems, a company that develops software for airlines.

Taxes and
the economy

MIT experts assess the candidates' differences

In the run-up to the Nov. 4 presidential election, the News Office has asked MIT experts to weigh in on the presidential candidates, their policy ideas and aspects of the campaign. In this installment in the series, Andrea Louise Campbell, the Hayes Career Development Associate Professor in the Department of Political Science, and James Poterba, the Mitsui Professor of Economics, look at economic issues and the proposed tax policies of the two presidential candidates.

Q: Both candidates have vowed to cut taxes. As indicated by the candidates' platforms posted on their respective web sites, what are the chief differences in the kind of taxes each candidate has vowed to cut?

Poterba: Sen. McCain has proposed increasing the exemption that taxpayers claim for dependents, reducing the corporate income tax rate (currently at 35 percent), and making permanent the personal income tax reductions that were enacted in 2001 and 2003, but that are scheduled to expire in 2010. The last proposal would fix the top personal income tax rate at 35 percent, which is the current rate, instead of 39.6 percent, the rate that prevailed prior to 2001. Sen. Obama has proposed preserving the current tax rates on single filers with less than \$200,000 in Adjusted Gross Income (AGI), and on married joint filers with AGI below \$250,000. Those with incomes above those levels would face tax increases as the current 33 percent tax bracket would rise to 36 percent, and the current 35 percent bracket would rise to 39.6 percent; the capital gains tax rate for these households would also increase. Sen. Obama also proposes a "Making Work Pay Credit" that would reduce taxes by up to \$500 for individuals with wage income, and by up to \$1,000 for married couples with two earners.

Q: Each accuses the other of raising taxes. Do you see any evidence that either candidate will raise taxes as indicated by their campaign statements online?

Campbell: The Tax Policy Center has calculated the impacts of these plans, and finds they have different fiscal and distributional implications. McCain's plan would reduce government revenues by \$4 trillion over 10 years, or about 11 percent of total revenue current scheduled for collection. Obama's plan would reduce government revenues by \$2.7 trillion, or 7 percent of

currently scheduled collections (keeping in mind that there will be rising budget deficits for decades to come even if revenues aren't reduced). Most of the benefit of Obama's plan would redound to lower- and middle-income people while most of the benefit of McCain's plan would redound to very high-income people.

Poterba: Sen. Obama's tax proposal is explicit in suggesting higher income tax burdens on single persons with AGI of more than \$200,000 and married couples with incomes above \$250,000. It is also possible that these households would see an increase in their payroll taxes, the taxes that are used to finance Social Security and Medicare.

James
PoterbaAndrea Louise
Campbell

Q: Both candidates say they will stimulate the economy. What do you think are the best ways this could be accomplished and does either candidate address those issues?

Campbell: Studies show that the stimulative effect of increased spending on unemployment benefits and food stamps is greater (more return per dollar spent) than the stimulative effect of the tax rebates that were issued this spring. But such tax rebates certainly have their political allure. Democrats in Congress want another round of rebate checks; I'm not sure about Obama's stance on that. However, the current financial sector meltdown is of such enormous scale that it eclipses such stimulus packages. I think both candidates are grasping for appropriate policies (as are Bernanke, Paulson and the world's finance ministers).

Q: How do the candidates address the impact of federal entitlement programs (Social Security, Medicaid, Medicare) as the Baby Boomer population ages?

Poterba: Neither candidate has offered a fully articulated plan for addressing the prospective deficits associated with either Social Security or Medicare/Medicaid. Of the two, the deficits associated with health insurance programs for retirees are more daunting, because they are attributable to a combination of an aging population and the projected increase in the real cost of health care services. Achieving long-term fiscal balance in Medicare and Medicaid is going to be very difficult without slowing the growth of health care costs, but the political challenges of doing that are very substantial.

Campbell: Beyond the current financial crisis, these are the issues that will determine the fiscal future of the United States.

For example, the Congressional Budget Office estimates that at current growth rates, health care — currently 1/6 of the economy — will constitute 100 percent of the economy in 2082, clearly an unsustainable trend. Social Security is a minor problem relative to Medicare. For Social Security, Obama proposes increased payroll taxes on those earning over \$250,000, which in conjunction with a few other policy changes, would meet much of the 75-year projected deficit in promised benefits. McCain proposes supplementing the current system with individual accounts, but

this does not address the long-term deficit in the program.

On Medicare, Obama proposes improving the prescription drug benefit, and "strengthening" and reducing waste in the main program. McCain proposes to control Medicare's growth by reforming the Medicare payment system.

However, neither candidate really takes on this extremely difficult issue, the most important one we face. Both duck the huge growth rates in Medicare/Medicaid spending projected for the next several decades. And McCain's larger program of health care reform, which entails giving individuals and families tax credits to purchase insurance while eliminating the current tax deductibility of health care premiums for individuals and employers, is a truly radical reform that upends the health care system that has existed since World War II. Many analysts see a host of problems with this reform, which they fear will leave many without insurance (those who can't afford it because the tax credit is too small, those who will be denied coverage because of pre-existing conditions, etc.).

CLASSIFIED ADS

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.

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Charting the 'path of professorship' for women

Stephanie Schorow

News Office correspondent

Sarah Bagby, an MIT biology graduate student, was accustomed in high school to being one of the few girls in her computer science, physics and calculus classes. But she was reminded of skewed gender ratios again at an MIT physics colloquium two years ago.

"I counted three other women in the audience, all apparently fairly junior," Bagby recalled. "We're empiricists. We pay attention to the available data. And when it looks like the experiment rarely works, and the experiment is life as a woman in science, it takes a lot of stubbornness and confidence to use your life as a replicate. Everyone is waiting for enough really stubborn women to accumulate as successful data points."

Which is why Bagby, and chemical engineering graduate students Anita Shukla and Ling Chao put in long hours to help Blanche Staton, senior associate dean for graduate education, organize MIT's third

"Path of Professorship" workshop this past Friday and Saturday. The workshop aimed to give a boost to graduate and postdoctoral women at MIT who are considering a tenure-track position in the fields of science, engineering, and technology.

The event included panel discussions on issues such as negotiation, tenure, managing teaching and service obligations — plus ample opportunity for networking and no-holds-barred discussions of work-life balance issues.

"Networking is the way to build up relationship," Chao explained. "When people have relationships, they can share information, experience, and resources, which would all enhance their academic careers."

Today, about 31 percent of MIT's graduate students are women, Staton said. Many don't opt for an academic career; "At some point along the way we lose them," she said.

More than a dozen female MIT faculty members, including Deborah Fitzgerald, the Kenan Sahin Dean of the School of Humanities, Arts, and Social Sciences,

made presentations at the workshop, which also featured faculty from Tufts, Northeastern, Wellesley, UCLA and the University of Maryland.

Institute Professor Mildred Dresselhaus — who, according to Staton, remembers the time when all of her students were men — gave the keynote address on Friday.

The "Path of Professorship" workshop grew out of a similar "Forward to Professorship" program, developed in Washington and brought to MIT in 2005. It proved so successful that Staton developed a more compact version specifically directed to the issues of MIT women. "It became clear to me that there was a need here," she said.

Bagby and Chao attended last year's workshop and, as Chao put it, "I became more encouraged and motivated when I saw many respectful role models, and was surrounded by many motivated participants who have similar goals, concerns and

struggles."

Some of the issues raised are concerns for working women everywhere, but other issues are specific to science. Shukla and Bagby noted that they work with radio-

active materials and powerful reagents that could affect a pregnancy. "I can make that decision to take the risk for myself," but it's a different matter if a child is expected, Bagby said.

"There is also a concern about how science advances so rapidly that if you step away two years, it could make a difference in your field," Staton said.

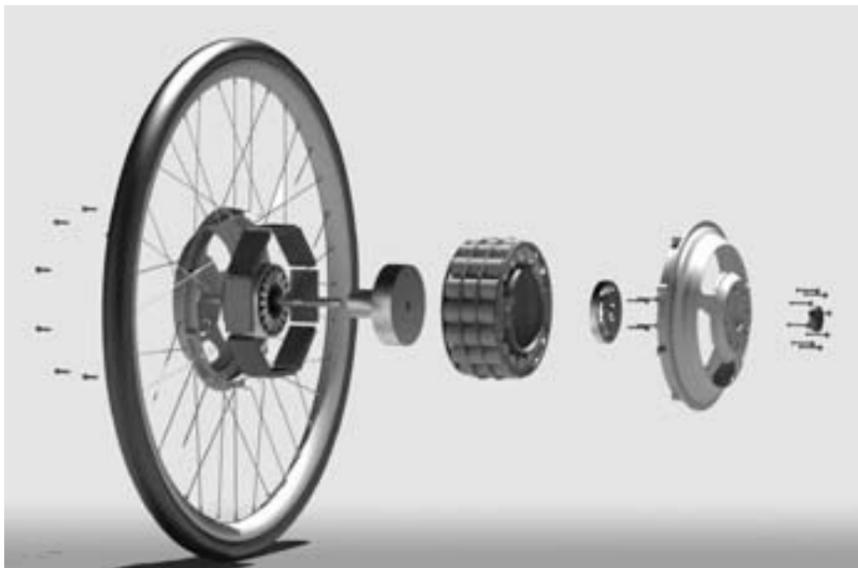
The workshop has even generated interest from members of the opposite sex, including one who requested details on a companion session for men.

"We don't have it, but talk to Dean Staton," Bagby told him.

"We all agree it would be fantastic if we didn't need this workshop. But we haven't come to that point yet," Bagby said.



Blanche Staton



MIT researchers unveiled a major new project on Oct. 10 in Copenhagen aimed at transforming bicycle use in Denmark's largest city, promoting urban sustainability and building new connections between the city's cyclists.

LEFT: The rear wheel with regenerative motor, as in a hybrid car, that will be used in the program. BELOW: Real time visualization developed for Copenhagen 2008 Culture Night.

IMAGES COURTESY OF THE SENSEABLE CITY LAB



MIT Deshpande Center awards fall 2008 research grants

The Deshpande Center for Technological Innovation at MIT recently announced it is awarding \$700,000 in grants to nine MIT research teams working on early-stage discoveries. These projects have the potential to make a significant impact on our quality of life by revolutionizing disease therapies, allergy diagnosis, HIV care in the developing world, drug discovery, energy-efficient displays, energy storage, and nanoscale imaging.

The fall 2008 grant recipients are:

- Utkan Demirci, affiliated faculty, Harvard-MIT Division of Health Sciences and Technology, and Martha Gray, Edward Hood Taplin Professor of Medical and Electrical Engineering (renewal from fall 2007 grant round)
- Gerald Fink, professor, biology; member, Whitehead Institute (renewal from fall 2007 grant round)
- Karen Gleason, Alexander and I. Michael Kasser Professor of Chemical Engineering
- Rohit Karnik, Brit (1961) and Alex (1949) d'Arbeloff Career Development Assistant Professor in Engineering Design, and Jeffrey Karp, affiliated faculty, Harvard-MIT Division of Health Sciences and Technology
- Susan Lindquist, professor, biology; member, Whitehead Institute (renewal from spring 2008 grant round)
- J. Christopher Love, Texaco-Mangelsdorf Career Development Assistant Professor of Chemical Engineering
- Donald Sadoway, John F. Elliott Professor of Materials Science and Engineering
- Henry I. Smith, professor of electrical engineering, and Rajesh Menon, research engineer, Research Laboratory of Electronics (renewal from fall 2007 grant round)
- Graham Walker, American Cancer Society Professor of Biology

For more details on the research projects, visit http://web.mit.edu/deshpandecenter/release_100808.html or <http://web.mit.edu/newsoffice/2008/deshpande-1008.html>.

NOBEL: MIT alumnus, former professor wins economics prize

Continued from Page 1

an associate professor of economics in 1980. With the exception of a year as international policy economist for the Council of Economic Advisers and two years as a professor at Stanford University, he was on the faculty at MIT until 2000, when he moved to Princeton. There he is a professor of economics and international affairs. He also writes a column for The New York Times.

"I'm very happy for him and for our department," Caballero said. "Paul is an MIT boy — he was a star student in the 1970s, and a member of our faculty for many years. His seminal work was done

on our premises. It is simply amazing how many Nobel prizes in economics have a strong link to MIT." Including Krugman, 18 MIT professors, former faculty, alumni and instructional staff have won the prize in economics; he is also the 73rd MIT-related Nobel prize winner.

Krugman's approach to trade and geography is based on the premise that many goods and services can be produced more cheaply in long series, a concept generally known as economies of scale. Meanwhile, consumers demand a varied supply of goods. As a result, small-scale production for a local market is replaced by large-scale production for the world market, where

firms with similar products compete with one another.

Traditional trade theory assumes that countries are different and explains why some countries export agricultural products whereas others export industrial goods. The new theory clarifies why worldwide trade is in fact dominated by countries that not only have similar conditions, but also trade in similar products — for instance, a country such as Sweden that both exports and imports cars. This kind of trade enables specialization and large-scale production, which result in lower prices and a greater diversity of commodities.



ALEXANDER VLADIMIR D'ARBELOFF, 1927-2008

Institute remembers 'force of nature'

Continued from Page 1

"By any measure, Alex's contributions to the Institute were distinctly nontrivial, and we continue to benefit from them today," Hockfield said. "Yet in the end ... the priceless gift that Alex gave to MIT was actually his spirit — the intrepid, unstoppable, brilliantly creative spirit of the chronic entrepreneur."

Dana Mead, who succeeded d'Arbeloff as chairman of MIT's governing body in 2003, said d'Arbeloff "relentlessly sought intellectual engagement in his life and work" while animating the experience of anyone who came in contact with him.

"We're all familiar with that frisson — what one feels at the advent of a great idea or a meeting of the minds," Mead added. "Alex, as we all know, admitted no impediment to his pursuit of that spark, and he lit our imaginations along with his own."

President Emeritus Charles M. Vest recalled the "boundless energy and enthusiasm" with which d'Arbeloff threw himself into his work at MIT — qualities Vest got to know only too well during their standing weekly meetings.

"The mental picture of him that I retain is dominated by his slightly shy, winsome grin when something amused or delighted him," Vest said. "He cared deeply for this institution, and together with our wonderful alumna, Brit, he left a great legacy in our minds, in our classrooms and laboratories, in our sports facilities and, above all, in our educational excellence."

Earlier this month, in a resolution expressing its sorrow and deep sense of loss, the MIT Corporation praised d'Arbeloff as a "force of nature" who brought "remarkable leadership, deep devotion and magnificent generosity" to MIT.

"We all experienced his laser-like intellect, his wry wit, his insatiable curiosity, his amazing ability to engage, cajole, persuade, educate and enlighten those with whom he came in contact," the resolution stated.

Other speakers at Friday's celebration were: William C. Morris '60, chairman of J. & W. Seligman & Company Inc.; Diana Henderson, professor of

literature and dean for curricula and faculty support; Gregory Mark '03, SM '05, founder of Aeromotion; Richard Dyck, president of TCS-Japan and East Asia Connector Services Inc.; Barrie Zesiger, founding partner and managing director of Zesiger Capital Group LLC and a member of the MIT Corporation; and Gururaj "Desh" Deshpande HM '07, founder and chairman of Sycamore Networks and a member of the MIT Corporation.

While the list of speakers was limited to 10, tributes have poured forth from scores of MIT community members who knew d'Arbeloff.

"Alex was always asking why we did things this way or that, or — more often — simply pronouncing that there was a better way," said former Vice President and Secretary of the Corporation Kathryn Willmore. "But just because he saw the world differently from many, perhaps most, of us in the university, this in no way lessened his devotion to this place. He was fiercely interested in everything and everyone he met, and once he took on a challenge, that was it. He certainly took on MIT — to our great benefit."

"An encounter with Alex wasn't always comfortable, but it was often fun, and it was always worthwhile," she added.

Mary Boyce, head of the Department of Mechanical Engineering, said d'Arbeloff "was a source of wisdom, inspiration and guidance" to the Institute and to her department, where he taught as a professor of the practice after he stepped down as chairman in 2003.

"His connection with faculty and students at MIT was truly genuine and personal because his story was and is the MIT story — always thinking of or challenging that new discovery, that next innovation, that next new technology and then working to make it happen," she said. "Alex d'Arbeloff will be missed."

Richard Schmalensee, the John C Head III Dean, Emeritus, of the MIT Sloan School of Management, said d'Arbeloff "was a source of wise counsel to me as dean" who "pushed all of us to be serious about advancing management education."

“*The mental picture of him that I retain is dominated by his slightly shy, winsome grin when something amused or delighted him.*”

Charles M. Vest
MIT president emeritus

For more photos from Alex d'Arbeloff's life, and the MIT Corporation resolution celebrating his life, visit web.mit.edu/newsoffice.