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TechTalk
SERVING THE MIT COMMUNITY

Pappalardo fellow Jocelyn Monroe peers into a neutron detector in development at MIT's Laboratory for Nuclear Science.
PHOTO / **DONNA COVENEY**

The quest for **DARK** matter

Tool will reveal when hypothetical particles are detected

David Chandler
News Office

Several research projects are underway to try to detect particles that may make up the mysterious "dark matter" believed to dominate the universe's mass. But the existing detectors have a problem: They also pick up particles of ordinary matter — hurtling neutrons that masquerade as the elusive dark-matter particles the instruments are designed to find.

MIT's Jocelyn Monroe, a Pappalardo fellow in the Department of Physics, has a solution. A new detector she and her students have built just finished its initial testing last week at Los Alamos National Laboratory. When deployed in the next few months alongside one of the existing dark-matter detectors, the new device should identify all of the ordinary neutrons that come along, leaving anything else that the other detector picks up as a strong candidate for the elusive dark matter.

"Dark matter experiments are very hard," explains Monroe, who worked on the project with undergraduates Dianna Cowern and Rick Eyers and with graduate students Shawn Henderson and Asher Kaboth. "They are looking for a tiny signal, from a phenomenon that happens very rarely," namely the collision of a dark-matter particle with one of ordinary matter, producing a tiny, brief flash of light.

Such flashes can be detected by

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Curtain goes up on Central Square Theater

Unique home for science-theater interplay has its grand unveiling

Stephanie Schorow
News Office correspondent

An unusual collaboration between theater and science was celebrated with a fundraising gala on Tuesday, Dec. 9, that officially opened the Central Square Theater (CST) and culminated an 11-year effort by MIT to revitalize a parcel of property in the heart of Cambridge.

While performances began earlier this year in the newly built facility at 450 Massachusetts Ave., Tuesday's event brought together long-time supporters of the project with actors, directors, MIT professors and staff in a special night hosted by MIT President Susan Hockfield and Boston's favorite maestro, Keith Lockhart.

"The opening of the Central Square Theater represents Cambridge at its finest," Hockfield said. "All corners of our community came together to realize this unusual project. Thanks to this broad partnership, Central Square now boasts two dynamic theater companies with a state-of-the-art performance venue to call home."

The mixed-use development project provides a permanent home to the long-standing Underground Railway Theater (URT) and The Nora Theatre and brings new opportunities for arts and culture that will help the revitalization of Central Square.

"CST is a huge win for Cambridge, MIT, the local cultural sector and for audiences throughout the area that are interested in contemporary drama and educational theater that appeals to and provokes dialogue for all ages," said Jason Weeks, executive director of the Cambridge Arts Council. "What a tremendous partnership. Everybody wins."

PHOTO / **ELIZABETH STEWART**

From left to right, Debra Wise, Robert Najarian and Steven Barkhimer perform in 'Einstein's Dreams,' a recent production at the new Central Square Theater.

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Santos honored for excellence in architectural education

SA+P dean wins prestigious Topaz Medallion

Adèle Naudé Santos, dean of the School of Architecture and Planning, is being honored with the 2009 Topaz Medallion for Excellence in Architectural Education, given by the American Institute of Architects (AIA) and the Association of Collegiate Schools of Architecture.

In a letter of support for her Topaz nomination, Edward Allen, the 2005 Topaz Medallion recipient, wrote: "For her entire working lifetime, she has been like a force of nature in architectural education and practice, inevitable and irresistible." BSA President Diane Georgopulos concurred: "As a practitioner, teacher, role model, leader, pioneer, mentor and articulate advocate of effective, innovative architectural education, Santos is a nonpareil soul whose impact on our profession and on both educators and students has been and continues to be extraordinary."

Santos was appointed dean of SA+P in 2004, having previously served as a professor at the University of California, Berkeley College of Environmental Design;

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News in brief

MIT TechTV relaunches

MIT TechTV, the video-sharing site for the MIT community, relaunched its site last week with a host of new features to make it more user friendly.

The new site offers a player that allows for time-code-based comments as well as the ability to make videos private. The site is now media RSS and iTunes enabled.

Phase two of the relaunch is expected to finish by the end of the calendar year and will provide increased privacy and sharing options that will allow users to post and share videos within a specific group. The general public will also be able to create guest accounts allowing them to post comments and create custom playlists.

Obituaries

Richard Filipowski, sculptor and former SA+P professor, 85

Richard E. Filipowski, a sculptor of international reputation who taught visual design in the School of Architecture and Planning for 36 years, died on Nov. 26. He was 85.

A graduate of the Institute of Design in Chicago, Filipowski joined MIT's faculty in 1952 as an associate professor and was the first to introduce the teaching methods of the German design philosophy Bauhaus to MIT. He developed a course on design theory that left a lasting influence on the school's design curriculum. He described his work of "finding form" as a "sustained search for spatial-structural-emotional concepts."

Filipowski retired from MIT in 1988, and in 2005 the MIT Museum honored his legacy in an exhibit called "Finding Form: The Artwork of Richard Filipowski."

Gifts in his memory can be made to MIT for graduate fellowships in the School of Architecture and Planning. Please send checks to the Dean's Office, MIT School of Architecture and Planning, 77 Massachusetts Ave. 7-231, Cambridge, MA 02139.

Alumnus returns to open eco-friendly food truck

Anne Wilson
MIT Campus Dining

When Ayr Muir '00, SM '01 left a corporate position to follow his passion for food, it led him back to MIT and to one of its most unique culinary segments: the food trucks.

The MIT food trucks are a popular destination for those looking for a hot, fast and relatively inexpensive meal. Now, thanks to Muir, customers can add descriptors such as "healthy," "locally sourced," and "eco-friendly" to their lunchtime lexicon.

"I feel like I've dedicated myself to an issue that matters," said Muir, whose truck, Clover, serves an entirely vegetarian menu that offers dishes made from local and organic ingredients. "I've always cared deeply about the environment and see this company as a way I can make real change."

Local sourcing helps Muir support the local economy and creates fewer carbon emissions. The eco-friendly vehicle runs on biodiesel, a fuel made from used vegetable oil, and subscribes to sustainable practices.

The truck's exterior pays homage to Muir's MIT past. It features a dry-erase board menu, which Muir says reminds him of the problem sets he faced as a student; and an arched, wood-frame awning that he built in MIT's Hobby Shop.

But the truck isn't just meant to be a destination for vegetarians or those with an appreciation for MIT culture; it's designed to appeal to anyone looking for healthy food options that don't sacrifice taste.

"Our customers are asking for healthier food options, they want to know where it comes from and how it is prepared," said Richard Berlin, director of MIT Campus Dining. "But they also want it to be exciting and taste good."

Muir hired Chef Rolando Robledo, formerly of The French Laundry, the Waldorf-Astoria, and most recently, a professor at Johnson & Wales University, to create flavors for Clover's menu that will appeal to everyone.

PHOTO / **PATRICK GILLOOLY**

Ayr Muir '00, SM '01, right, helps dole out soup at his food truck, Clover, which is the newest addition to MIT's food truck population on Carleton Street. Clover is an all-vegetarian, eco-friendly mobile eatery.

MIT News Office tip

Try Clover's French fries with rosemary. They're delicious!

Creative soups, fresh-cut French fries and an atypical sandwich selection have been popular with lunch crowds. Sandwiches include varieties such as egg and eggplant, soy BLT, and BBQ Wheat Protein. Clover started serving breakfast on Monday, Dec. 1. The entire menu will change seasonally and will develop based on customer preferences and tastes.

If you stop by Clover in the coming weeks you'll see Muir and Robledo, wearing blue aprons. In the French brigade system, a hierarchy used in hospitality, each color apron has a meaning.

"Blue is reserved for the apprentices, those learning," Muir said. "[Robledo] chose the blue aprons as a symbol of humility, and the expectation that we're always learning."

Clover is located on Carleton Street behind MIT Medical and the Kendall Square inbound MBTA stop. Operating hours are Monday through Friday from 8 a.m. to 3 p.m. Read more about the development of Clover on Muir's blog, www.cloverfoodlab.com.

As a final note, Muir's concept is unique but the alumni story doesn't stop there — Campus Dining also welcomed Sandi Simester SF '03 and Mike Rorick SF '03 back to campus this fall as the owners and operators of Zigo Café.

Zigo, which already had two locations in Kendall Square, opened its newest shop in W98, which, appropriately, is also the new home of the MIT Alumni Association.

For more information about Clover, Zigo Café and other Campus Dining operations, please visit web.mit.edu/dining.

Cima named faculty director of Lemelson-MIT Program

PHOTO / **DONNA COVENEY**

Michael J. Cima

Succeeding Flemings as of Jan. 1, 2009

The Lemelson-MIT Program has announced that Michael J. Cima, the Sumitomo Electric Industries Professor of Engineering, will be its new faculty director, effective Jan. 1, 2009.

Cima, of the Department of Materials Science and Engineering (DMSE) and the Koch Institute for Integrative Cancer Research, is a recognized expert in the field of materials processing. He is actively involved in materials and engineered systems for improvements in human health, such as treatments for cancer, metabolic diseases, trauma and urological disorders. He is also a co-inventor of MIT's three-dimensional printing process, co-founder of four companies in the health-technologies field and advisor to the MIT Glass Lab.

Cima succeeds Merton Flemings, the Toyota Professor of Materials Processing Emeritus of DMSE, who has served as the Lemelson-MIT Program faculty director since 2001. During his tenure, Flemings oversaw the launch of Lemelson-MIT InvenTeams, the growth of the Lemelson-MIT Awards and the birth of EurekaFest, the program's annual multiday celebration designed to empower a legacy of inventors.

The Lemelson-MIT Program recognizes outstanding inventors, encourages sustainable new solutions to real-world problems, and enables and inspires young people to pursue creative lives and careers through invention. The program administers the InvenTeam initiative, which awards grants to teams of high school students, teachers and mentors to invent; and the Lemelson-MIT Awards, which include the $500,000 Lemelson-MIT Prize, the $100,000 Lemelson-MIT Award for Sustainability and the $30,000 Lemelson-MIT Student Prize.

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Live close, live affordable

Rental units available at Third Street complex; MIT employees may be eligible

Patrick Gillooly
News Office

Thirty-four affordable-housing rental units are now available for income-eligible households — including MIT employees — at 285 Third Street, which is part of a two-building complex envisioned as a university residential area by MIT President Emeritus Paul Gray and colleagues.

The City of Cambridge is helping to identify qualified applicants for these affordable units, which are affordable under the requirements of the city's inclusionary housing program. Cambridge's Community Development Department is now accepting applications from households who meet income and asset requirements. Applicants must earn less than 80 percent of area median income adjusted by family size:

- One-person household: $46,300
- Two-person household: $52,950
- Three-person household: $59,550
- Four-person household: $66,150
- Five-person household: $71,450
- Six-person household: $76,750

Residents in affordable rental units will pay 30 percent of their monthly income for rent and utilities. Preference will be given to Cambridge residents and families with children, with secondary preference given to applicants who work in Cambridge. MIT employees and their families are encouraged to apply, Cambridge Housing Director Christopher Cotter said.

MIT Human Resources Vice President Alison Alden also noted the unique option available to those MIT employees who qualify.

"This is a wonderful opportunity to have more of the MIT community living within walking distance of their jobs at the Institute," Alden said.

The city will hold two information sessions where staff will review how to complete an application for these units and the review and selection process. Both sessions — at 10 a.m. Saturday, Dec. 13, and at 6 p.m. Monday, Dec. 22 — will be held at the City Hall Annex, 344 Broadway.

At 285 Third Street, the 34 available units include four studios, 16 one-bedroom units, 11 two-bedroom units, one three-bedroom unit, one accessible studio and one accessible two-bedroom unit. The rental units are in the same development as the 303 Third Street building, where several MIT faculty and staff members have already purchased condominiums; several MIT-affiliated families also live at 285 Third Street.

The application deadline for these units is at 7 p.m. Monday, Jan. 5.

For more information or to obtain an application, visit www.cambridgema.gov/cdd/hsg/available/hsg_available.html or call the City of Cambridge Housing Division at 617-349-4622.

CST: Curtain goes up on unique home for science-theater interplay

Continued from **Page 1**

The history of the $8 million CST project goes back to the late 1990s, when MIT began to consider options for renovating deteriorating structures it owned on Massachusetts Avenue, including a café and convenience store. Working with the Cambridge Historical Commission and other city agencies as well as the Nora and URT — both founded in Cambridge but which lacked physical homes — the Institute developed a plan to replicate aspects of the original structure and develop a state-of-the-art, black-box theater and retail and office space. The companies are paying below-market rent for the space.

Since opening in July, CST has featured five productions, nearly all of which sold out.

WHEN SCIENCE AND ART INTERSECT

The theater also provides a venue for the Catalyst Collaborative@MIT, founded about three years ago by MIT and URT with the aim of, as Hockfield put it, "mining the deep vein of theatrical possibility at the intersection of science and the arts." The collaborative has held staged readings and two full productions, including a much-praised rendition of "Einstein's Dreams," a play based on the novel by Alan Lightman, adjunct professor of the humanities, which continues through Dec. 14 at CST.

"The work that has been accomplished [by CC@MIT] has been nothing short of amazing," Weeks said. The collaborative has brought together traditional theatergoers with the scientific community as well as MIT students and faculty, he said.

> *[The Central Square Theater] is a huge win for Cambridge, MIT, the local cultural sector and for audiences throughout the area ... What a tremendous partnership. Everybody wins.*
>
> **Jason Weeks**
> **executive director, Cambridge Arts Council**

For example, the CC@MIT has held "talk backs" or postshow discussions by MIT professors and staff on science or technology topics at CST, a feature that has become as popular as the plays themselves.

"If 200 people show up for a play, 175 stay for the 'talk back,'" said Catherine Carr Kelly, CST executive director. "I think the clear message is people want to have this conversation [about science]; they want to be entertained while having it."

Beginning in April, the URT will present a new translation of the Bertolt Brecht play, "Galileo," and CC@MIT has been commissioned by the National Institutes of Health to write a play to mark the 150th anniversary of Darwin's "The Origin of Species." Melinda Lopez, a recognized playwright, is currently working on the script, Carr Kelly said. The result will probably be performed during the 2010 season.

Both MIT and theater staff praised the cross-fertilization among MIT students and faculty and actors, directors and playwrights through CC@MIT projects.

"The dialog between the artists and the scientists has been lively, has been exciting," said MIT Professor of Theater Arts Alan Brody, who directs the Catalyst Collaborative with Janet Sonenberg, professor of theater arts and section head of music and theater arts; and URT Artistic Director Debra Wise. "We're learning about each other — how we think."

A project such as the collaborative "helps demystify science and helps create a kind of science literacy," Brody said, adding, "It's very important to me as a playwright — it's important for all of us — to get the facts right, too."

CST also hosts a range of other plays: through Dec. 28, the URT is presenting "Alice's Adventures Underground"; in January, the Nora will present Anton Chekhov's classic work, "The Cherry Orchard." Other efforts, including special reduced-price nights for local residents, target ways to welcome the theater's Central Square neighbors.

Tuesday's gala gave patrons a taste of the range of energy and creativity of the two resident theater companies, with a red-carpet treatment, a glimpse into rehearsals for the youth theater group and a specially choreographed "Office Dance," as well as staged readings, a building tour and a live auction.

For more on the Central Square Theater, visit centralsquaretheater.com.

PHOTO / **LISA DAMTOFT**

Sayonara cigarettes

Kari Williams '11, a member of the Cig-ARRETE team, works on her creation for the recent 'Kick-Butt' design competition sponsored by MIT Medical. The goal was to build a deliberately over-engineered mechanical apparatus to perform the simple task of extinguishing a cigarette.

Events at MIT

Log off, drop in, rev up: Take a 'winter break'

Today from 4-5 p.m. in Lobby 7 there will be a special break-from-winter event, complete with music, refreshments and more. The event is sponsored by the Undergraduate Association, the Graduate Student Council and the Office of the President. Open to MIT faculty, staff and students.

Today

• **Holiday Greens Sale.** From 8:30 a.m.-2 p.m. in Lobby 10. The MIT Women's League will have decorated wreaths, mantel pieces and fresh holly to decorate your homes. We will be joined by the MIT Endicott House with their beautiful houseplants, and holiday gifts for sale.

• **MIT Press Book Sale.** 10 a.m.-4 p.m. in Lobby 13. The Campus Sale is back! By popular demand, the MIT Press Bookstore will hold a December book sale. This sale will be in the style of the famous loading-dock sales and will have 10,000 pounds of books ready to sell at drastically reduced prices. Each book will be $10 or less.

• **NextLab Event 2008: Can MIT students make a cell phone change the world?** 11:30 a.m.-3:45 p.m. in E15-Lower Atrium, Bartos Theater. See how MIT students, together with seven partner organizations across the developing world, are designing and deploying new ways of using mobile technologies to address some of the most pressing problems of international development.

• **John D. Roberts Celebration Lecture.** 4-5:30 p.m. in 6-120. A celebration of a chemical breakthrough award from the American Chemical Society to Professor John D. Roberts, Institute Professor of Chemistry Emeritus, California Institute of Technology, for his historic discovery at MIT of the benzyne mechanism in aromatic amination reactions.

Thursday, Dec. 11

• **Seminar in Space, Policy, and Society: "The Great Leap Upward: A Review of the Chinese Space Program."** Dean Cheng, senior Asia analyst, CNA, will speak. 5-7 p.m. in 33-206.

Friday, Dec. 12

• **Armadillo: FEMA Trailer Transformation Build Party and Smudge Cleansing.** Noon-4 p.m. at 620 Putnam Ave. (between Sidney and Waverly streets). The MIT FEMA Trailer is now undergoing transformation into Armadillo: a composting station and vertical garden. Learn how your organization/school/agency/family can submit an application to receive the transformed trailer.

Submit your events!

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

Reversing conventional DNA wisdom

Researchers find DNA is transcribed by divergent polymerases

Anne Trafton
News Office

The copying of DNA's master instructions into messenger molecules of RNA, a process known as DNA transcription, has always been thought to be a unidirectional process whereby a copying machine starts and moves in one direction. But in work that represents a fundamental shift in scientists' understanding of the phenomenon, MIT researchers have found evidence that two DNA copying machines frequently start from the same site and move in different directions.

MIT Institute Professor Phillip Sharp and his colleagues, who reported the results in the Dec. 4 early online edition of Science, believe this new mechanism may play a role in keeping genes poised for transcription.

"People have been studying transcription for a long time and never seen this kind of transcription before," said Amy Seila, a postdoctoral associate in Sharp's lab and lead author of the paper.

DNA, which is housed within the nucleus of cells, controls cellular activity by coding for the production of enzymes and proteins. The genetic information in DNA is not directly converted into proteins, but must first be copied, i.e. transcribed, into RNA.

During normal transcription, an enzyme called RNA polymerase binds to a gene's transcription start site, and then proceeds downstream along the DNA, copying the sequence and producing messenger RNA that carries the gene's instructions.

In the new scenario, a second RNA polymerase is believed to bind near the starting point and move upstream, producing a short RNA sequence that doesn't code for any proteins.

"It looks like we have a polymerase that binds as we thought, but we also see a polymerase that appears to be pointing in the wrong direction, going upstream from the transcription start site," Seila said.

The researchers believe that upstream and downstream RNA polymerases, or divergent polymerases, are "paused" on the DNA and keeping the transcription start site open, so the gene can be easily accessed and transcribed.

The MIT team postulated this divergent transcription after discovering a new class of small RNA, which they dubbed TSSa-RNA because it is associated with transcription start sites.

The researchers found from analysis of tens of millions of short RNA sequences that many of these RNAs were clustered just upstream of gene transcription start sites, suggesting that DNA transcription is occurring in the reverse direction. Many of the genes where these short RNAs were found are very active, supporting the theory that this mechanism helps promote gene transcription.

The researchers observed this phenomenon in several kinds of cells in both humans and mice, leading them to believe that it is universal.

A paper by another researcher, John Lis of Cornell University, offers independent evidence for the same theory. In a paper also appearing online in Science last week, Lis reports finding RNA polymerases sitting on genes both upstream and downstream from transcription start sites, waiting to be activated.

Sharp's lab plans to undertake further experiments to determine what roles these transcription start site-associated RNAs play in gene regulation, and whether they might interact with other types of small RNA such as microRNA.

"This is only the beginning of the story. It's certainly not the end of the story," Sharp said.

Other authors of the paper are J. Mauro Calabrese, a former graduate student in Sharp's lab; Stuart Levine and Peter Rahl, postdoctoral associates in the Whitehead Institute; Ryan Flynn, a junior biology major; Richard Young, professor of biology and member of the Whitehead Institute; and Gene Yeo of the University of California at San Diego.

The research was funded by the National Institutes of Health, the Crick-Jacobs Center for Computational Biology, and the National Cancer Institute.

PHOTO / **JASON DORFMAN**

EECS graduate student Michael Bernstein.

Anne Trafton
News Office

Everyone has them — little squares of colorful paper stuck on monitors, business cards strewn across desks, and to-do lists tucked away in pockets. These information scraps feature critical phone numbers, meeting dates and shopping lists — and they have an alarming tendency to vanish just when you need them.

In an attempt to better organize those scraps, a team of MIT computer scientists has developed several software programs that allow users to easily enter, store and retrieve all kinds of information, from e-mail addresses to a list of restaurants you've visited.

The researchers, led by MIT Professor of Electrical Engineering and Computer Science David Karger, consider sticky notes ideal for certain problems, but think many of the tasks people use them for would be better handled by a computer.

"I would never make the claim that we're trying to replace Post-its," says Michael Bernstein, a grad student in Karger's lab, part of MIT's Computer Science and Artificial Intelligence Laboratory. "We want to understand the classes of things people do with Post-its and see if we can help users do more of what they wanted to do in the first place."

After studying how people keep track of their information scraps, the team has developed and tested a few different systems to help handle such odds and ends, from comprehensive programs that capture broad context for every scrap, to streamlined, web-based note-taking software.

In their 2007 study of personal information scraps, the team found scraps not only on sticky notes, but an array of other improvised tools — notebooks, whiteboards, text files, Internet bookmarks, and e-mails to oneself.

"We started out asking what people do with Post-it notes, and it spiraled into something much bigger — a study of how people intentionally misuse all of those systems that are supposed to help you," says Bernstein, who has worked closely with graduate student Max Van Kleek on the information scrap project.

In addition to to-do lists and phone numbers, the researchers found many other unique kinds of information, including fantasy football rosters, travel price comparisons, and a list of guitar chords.

Such information is difficult to capture because there are no specific computer applications designed to store them. Many people don't even use specific systems such as calendars and address books due to lack of what the researchers term "lightweight capture." If too much time and effort is required to store information, most people won't bother.

However, that means there is no easy way to find that phone number, recipe or other note to yourself when you need it. "You can't retrieve it on your computer if it never got put in," says Karger.

The group has explored a variety of tools aimed at increasing the flexibility and decreasing the burden of information capture. The first, called Jourknow, captured context every time the user made a note, such as where he was and what web site he was looking at. That feature saves the user the work of entering all that information, and the extra context makes it easier to find stored information later on, but all that extra work made the system too slow and complicated.

A second effort, Inky, was co-developed with Robert Miller, the NBX Career Development Associate Professor in the Department of Electrical Engineering and Computer Science, and with graduate student Vikki Chou. Inky tried to "understand" the notes users were writing and automatically place them in the right applications, for example reserving a conference room on the lab's booking system when the user typed "meeting John 5pm."

Most recently, the group has been developing a tool called list.it, which focuses entirely on minimizing the time and effort needed to capture information. List.it is a simple web-browser-based note-taking tool that allows users to jot down short notes. Once the information is stored, it can be easily searched for later retrieval.

In a study to be presented at the CHI human-computer interaction conference next spring, the researchers found list.it enabled users to quickly capture information and find it later. People who tested the system began to use list.it to store to-dos, appointments and other information that was previously never captured or had lived in other applications, due in part to the speed of interaction with the system.

"Even a simple text capture box and a text search box is well suited to a task that is both common and important: managing the small information scraps that fall between the cracks of traditional information management tools," the researchers concluded.

The researchers encourage interested users to try out list.it for themselves. The program can be downloaded at http://listit.csail.mit.edu.

Graduate student Katrina Panovich is also working on the information scrap project, which is funded by the Nokia Research Center Cambridge, the National Science Foundation, the Royal Academy of Engineering, the Web Science Research Initiative and Quanta Computer.

Want to try list.it?
Check it out at
listit.csail.mit.edu

Finding better materials for solar cells

New research could lead to cheaper cells with vast potential

David Chandler
News Office

New research by teams of MIT scientists and students could lead to cheaper and more efficient solar cells in the next few years, either by incorporating materials that are so abundant that they could support a major boom in the industry or by cutting production costs for conventional solar cells.

Tonio Buonassisi, the SMA Assistant Professor of Mechanical Engineering and Manufacturing, says the research is a systematic attempt to explore the kinds of materials that could be used for future solar cells. Some reports on the progress by Buonassisi and his co-workers were presented on Dec. 3 at the Materials Research Society meeting in Boston.

In order to sustain major growth in the solar industry, materials used to make solar cells must be abundantly available, so one team began by looking at the 30 or so elements in the Earth's crust that are abundant enough to support the development of terawatts (trillions of watts) worth of solar cells — enough to make a substantial dent in the world's energy needs. They then came up with a list of more than 500 compounds made from these elements that have the necessary semiconductor properties. Of these, they selected about 10 that appeared most promising for more detailed study.

The first of these compounds to be studied in detail was cuprous oxide (Cu_2O) — a reddish mineral used as a pigment and fungicide. "It is promising, the optical properties are just right," Buonassisi said. "But the electrical properties are not up to snuff," so they are using defect engineering methods to try to improve that. Meanwhile, they will continue to work through the remaining candidate compounds.

How quickly this work could translate into a new commercializable solar cell depends on how the different possibilities pan out, he said. "We could get lucky and hit gold next semester, or it could take three to five years," he said. Either way, it's an important avenue of systematic research to pursue: "It's an exploration we can't afford not to do," he said.

CUTTING COSTS

Another avenue of research being pursued is trying to cut the cost of the highly purified silicon used to make conventional solar panels. Normally, silicon-rich ore such as quartz is heated in an arc furnace so that the impurities separate out — a very energy-intensive process. But it turns out that nature may have provided a better way.

The impurities are not uniformly distributed in the quartz, but are concentrated in small pockets, called precipitates, and thus could be largely chemically or mechanically separated before the melting process.

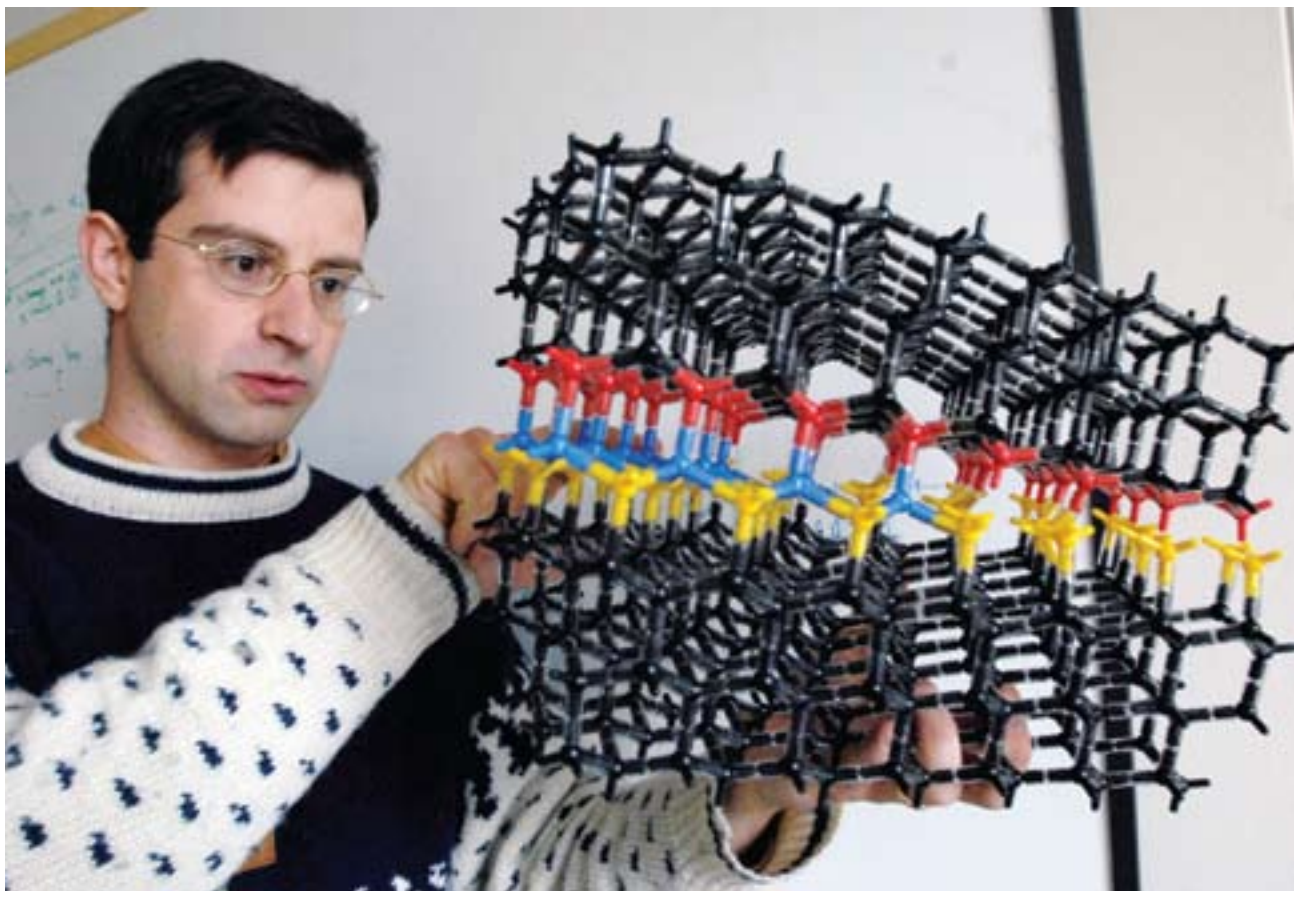

PHOTO / **DONNA COVENEY**

Mechanical Engineering Professor Tonio Buonassisi holds a model illustrating a defect in silicon solar cell material (in blue).

"Experience has shown that the impurities are clustered," Buonassisi said. "If one develops a process for removing these impurities before melting, that could eliminate steps in purifying." Silicon manufacturers have already expressed interest in the research, he said.

Buonassisi and other MIT colleagues are also working on improving the efficiency of solar cells made using multicrystalline silicon, rather than the much-more-expensive single-crystal wafers such as those used for computer chips. The problem is that in the multicrystalline material, defects within the grains called dislocations tend to soak up a lot of the energy produced, but the MIT researchers told the Materials Research Society meeting that they have found a process for greatly reducing the losses.

Essentially, it consists of reheating the material after it has initially cooled down in the manufacturing process, a technique known as annealing. By controlling the temperature profile just right, the energy-sapping dislocations can be reduced by more than a hundredfold — bringing it to nearly the same crystal quality as the pure, single-crystal form.

This part of the research is already well advanced, Buonassisi said, and the team is beginning to work with manufacturers to bring it to market. Pilot runs are expected within a year, and full-scale production soon thereafter, he said. The group published a report on this work this fall in Applied Physics Letters.

In addition to Buonassisi, the research projects have been carried out by Gerbrand Ceder, the Richard P. Simmons (1953) Professor in Metallurgy, mechanical engineering graduate students Yun Seog Lee and Steve Hudelson, postdoctoral fellows Mariana Bertoni and Bonna Newman in the Laboratory for Manufacturing and Productivity, physics graduate student Maria K. Chan, and materials science and engineering graduate students Katy Hartman and Sarah Bernardis.

The group also collaborated with researchers elsewhere, including Rune Larsen of NTNU, Norway, Marisa di Sabatino of SINTEF, Norway, and Matthew Marcus and Sirine Fakra of the Advanced Light Source, Berkeley, on the quartz refining project.

This research was supported by the U.S. Department of Energy's Solar America Initiative, the MIT Energy Initiative, the family of Doug and Barbara Spreng, and the Chesonis Family Foundation.

Researchers seek a better flight plan for weather forecasting

Flying robots could give people more time to prepare for the worst

Rachel Kremen
News Office correspondent

At MIT, planning for bad weather involves far more than remembering an umbrella. Researchers in the Department of Aeronautics and Astronautics are trying to improve weather forecasting using robotic aircraft and advanced flight plans that consider millions of variables.

"Weather affects huge sectors of our economy, such as agriculture and transportation," said Nicholas Roy, an assistant professor and one of the researchers who worked on the project. With more time for advanced planning, farmers could bring in their crop before a big storm hits. Airlines could adjust their flight schedules further in advance, reducing the impact on customers.

Improving weather forecasting could also save lives. "People do get killed in these storms," said Aero-Astro Professor Jonathan How, the principal investigator. The more time to prepare for a storm and evacuate the area, the better. Currently, forecasts made more than 48 hours in the future aren't considered highly reliable.

The researchers hope to gain some lead time by improving the way data about current weather conditions are collected. Existing forecasting systems depend on pressure, temperature and other sensors aboard a single piloted airplane that flies scripted routes. But the data that are collected can't be processed fast enough to alter the flight plan if a storm starts brewing. "The response time is fairly slow," How said. "Today's flight path is based on yesterday's weather."

Ideally, teams of unmanned aircraft would be used to gather data. Current sensor readings from one plane would be used to guide the deployment of additional planes to areas with especially interesting or changing weather. By gathering information from several key areas at the same time, the researchers believe they could offer more accurate forecasts.

"We'd like to better predict the weather three to five days in advance," said Han-Lim Choi, a postdoctoral associate in How's lab.

But this is no easy task, largely because weather involves extremely complicated interactions between a lot of different factors. And while the researchers focused their work on the area over the Pacific Ocean, this was still a vast expanse to consider in terms of automated flight planning. Traditional robotic planning algorithms don't scale well to problems of that size, How explained. So the key challenge was creating an algorithm that could develop an effective flight plan quickly, based on millions of variables.

ILLUSTRATION / **REBECCA MACRI**

After three years of research using computerized weather simulations, the team believes their algorithm can quickly and efficiently determine where aircraft should be sent to take the most important measurements. Essentially, the algorithm works by determining the relative utility of taking different flight paths to gather measurements. How said their system can create a new flight plan within six hours of collecting data.

PHOTO / **DONNA COVENEY**

Jonathan How

Choi, who recently earned an MIT PhD for his work on the project, will describe the research at this month's IEEE Conference on Decision and Control.

How said the results of the research could reach far beyond weather prediction. Intelligent path planning is essential for all kinds of mobile robots, be they autonomous cars or mail-carrying robots. The research could also be used, How noted, to help environmental engineers determine where best to take samples to determine the source of a contaminant.

Although the system has not yet been used with real aircraft, How's team continues to test their algorithm against increasingly complex weather models with the help of former MIT meteorologist James Hansen, who is now with the Naval Research Laboratory.

The research was funded by the National Science Foundation.

(Additional reporting by Elizabeth Thomson)

Dimmest star-like objects discovered

David Chandler
News Office

Whitney Clavin
NASA Jet Propulsion Laboratory

The two faintest star-like objects ever found, a pair of twin "brown dwarfs" each just a millionth as bright as the sun, have been spotted by a team led by MIT physicist Adam Burgasser.

"These brown dwarfs are the lowest power stellar light bulbs in the sky that we know of," said Burgasser. And these extra-dim brown dwarfs may be the first discoveries of the predominant type in space. "In this regime [of faintness] we expect to find the bulk of the brown dwarfs that have formed over the lifetime of the galaxy," he said. "So in that sense these objects are the first of these 'most common' brown dwarfs, which haven't been found yet because they are simply really faint."

Burgasser, an assistant professor of physics at MIT, said "both of these objects are the first to break the barrier of one millionth the total light-emitting power of the sun." He is lead author of a paper about the discovery appearing today in the Astrophysical Journal Letters.

Astronomers had thought the pair of dim bulbs was just a single typical, faint brown dwarf with no record-smashing titles. But when Burgasser and his team used NASA's Spitzer Space Telescope to observe the brown dwarf in infrared light, it was able to accurately measure the object's extreme faintness and low temperature for the first time. The Spitzer data revealed that what seemed to be a single brown dwarf is in fact twins.

Brown dwarfs are compact balls of gas floating freely in space, too cool and lightweight to be stars but too warm and massive to be planets. The name "brown dwarf" comes from the fact that these small star-like bodies change color over time as they cool, and thus have no definitive color. In reality, most brown dwarfs would appear reddish if they could be seen with the naked eye.

When Burgasser and his collaborators used Spitzer's ultrasensitive infrared vision to learn more about the object, thought to be a solo brown dwarf, the data revealed a warm atmospheric temperature of 565 to 635 Kelvin (560 to 680 degrees Fahrenheit). While this is hundreds of degrees hotter than Jupiter, it's still downright cold as far as stars go. In fact, the brown dwarfs, called 2MASS J09393548-2448279, or 2M 0939 for short, are among the coldest brown dwarfs measured so far.

To calculate the object's brightness, the researchers had to first determine its distance from Earth. After three years of precise measurements with the Anglo-Australian Observatory in Australia, they concluded that 2M 0939 is the fifth closest known brown dwarf to us, 17 light-years away toward the constellation Antlia. This distance together with Spitzer's measurements told the astronomers the object was both cool and extremely dim.

But something was puzzling. The brightness of the object was twice what would be expected for a brown dwarf with its particular temperature. The solution? The object must have twice the surface area. In other words, it's twins, with each body shining only half as bright, and each with a mass of 30 to 40 times that of Jupiter. Both bodies are one million times fainter than the sun in total light, and at least one billion times fainter in visible light alone.

Burgasser said studying these objects could help astronomers understand details of brown dwarf structure and evolution. These observations "allow us to see for the first time what the atmospheres of very old and/or very low mass brown dwarfs contain and how they are structured," he said.

Other authors of this paper are Chris Tinney of the University of New South Wales, Australia; Michael C. Cushing of the University of Hawaii, Manoa; Didier Saumon of the Los Alamos National Laboratory, N.M.; Mark S. Marley, NASA Ames Research Center, Moffett Field, Calif.; and student Clara S. Bennett ('10) of MIT.

The work was funded in part by a NASA grant.

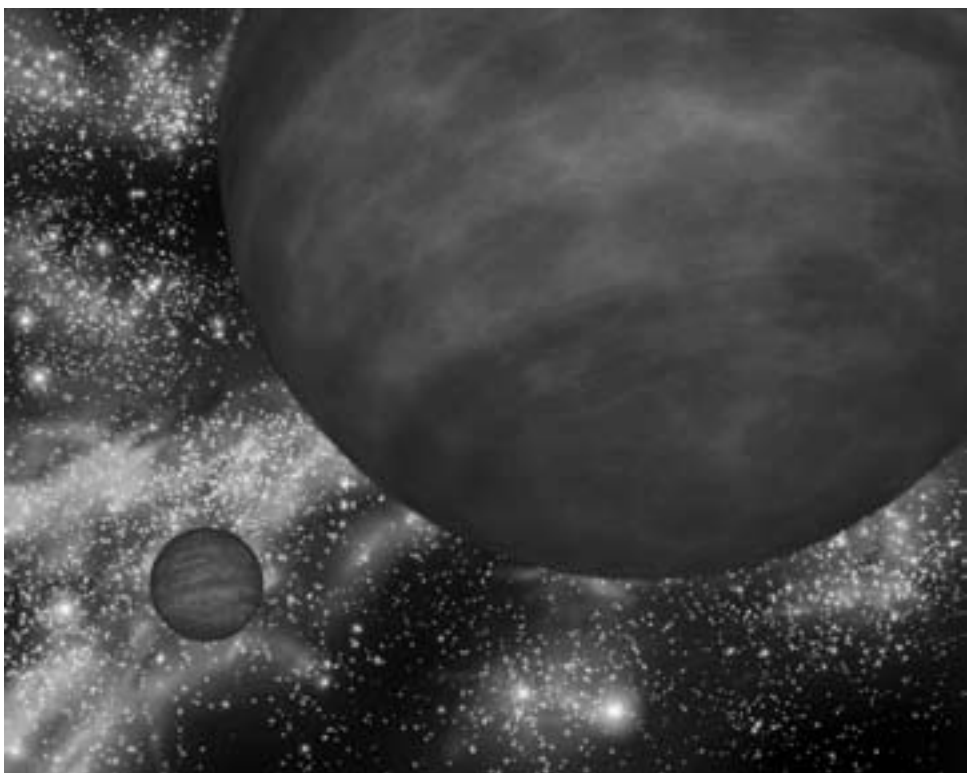

IMAGE / **ROBERT HURT; NASA-JPL**

ABOVE: An artist's rendering of the dimmest star-like bodies currently known — twin brown dwarfs referred to as 2M 0939. The twins, which are about the same size, are drawn as if viewed from one side.

PHOTO / **DONNA COVENEY**

LEFT: Professor Adam Burgasser

DARK: MIT-designed detector may reveal hypothetical particles

Continued from **Page 1**

putting a tank of liquid deep underground to shield it from most stray particles, then lining the tank with photomultiplier tubes that can pick up even the faintest bursts of light.

The problem is, even buried a mile underground, calculations show such detectors will pick up far more collisions from particles of ordinary matter than from those made of the still-unknown particles of dark matter. To be precise, the ordinary collisions should happen about 10 billion billion times (19 orders of magnitude) more often than the dark-matter collisions. So learning how to rule out those ordinary collisions is the key to finding the unknown matter.

"We're really trying to characterize the background," Monroe explains. "We're making a precise measurement of the energy spectrum of the neutron background." By understanding the nature and intensity of this background, it will be possible to design more effective shielding material.

And by running the two detectors at the same time, anytime a signal is seen in the neutron detector, any signal seen simultaneously in the dark-matter detector can be safely ignored. Only when the dark matter detector sees something and the neutron detector doesn't will there be a chance that one of the elusive dark-matter particles has been found.

Dark matter experiments are very hard. They are looking for a tiny signal, from a phenomenon that happens very rarely.

Jocelyn Monroe, physicist

Nobody knows what the dark matter is made of, but astronomers are sure it's there because of the way its gravitational attraction pulls on other, visible matter in space. That allows them to determine just how much of the mystery matter is out there — more than five times as much as the amount of ordinary matter — but not what it's made of.

Theorists have come up with a variety of candidates, but the leading contenders are a class of subatomic particles known as WIMPS — weakly interacting massive particles. These are the types of particles, including one called the neutralino, which should be detectable by the deep underground experiments.

"I think probably in the next five years, someone will see a candidate" for a dark-matter particle, Monroe says. Although some experiments have already claimed to see possible evidence of dark matter, so far those claimed results "are surprising and unconfirmed," Monroe says, and have not been accepted by most scientists.

To test the new detector, Monroe and her students took it to Los Alamos National Laboratory, where it was exposed to a neutron source so that its sensitivity could be precisely calibrated. Once the analysis of that test is completed, the device will be sent out to an underground laboratory, most likely at the planned Deep Underground Science and Engineering Laboratory. This facility, though not yet funded, would be set up in the Homestake Mine, a very deep old gold mining complex in South Dakota, and one of its multidisciplinary goals is to provide the world's deepest location for the detection of cosmic dark matter.

The research is partly funded by the National Science Foundation.

Epidemiological study proves that tainted heparin caused allergic reactions

Anne Trafton
News Office

A team of researchers has confirmed that a contaminant found in several batches of the blood-thinner heparin is linked with severe allergic reactions in patients, dozens of whom died after receiving the tainted drug.

A study conducted by the researchers provides epidemiological evidence that contaminated batches of heparin produced in China sickened hundreds of people, said MIT Professor Ram Sasisekharan.

Sasisekharan is the senior author of the study, which appeared in the Dec. 3 online edition of the New England Journal of Medicine.

The tainted heparin scandal is among several recent contamination incidents involving products from China. It unfolded between November and January, when hundreds of patients in the United States and several other countries suffered allergic reactions after receiving the drug, often administered during dialysis or heart surgery. The tainted heparin came from factories in China that manufacture the drug for Baxter International, which recalled its heparin in February.

This demonstrates the importance of analytical methods in contributing to the safety of medications.

Jeremy M. Berg
director, NIH's National Institute of General Medical Science

In April, an international team led by Sasisekharan identified the chemical structure of the contaminant, oversulfated chondroitin sulfate (OSCS), and demonstrated the biological mechanism for how it could cause severe allergic reactions in humans.

The new NEJM study epidemiologically connects the adverse reactions to the OSCS-contaminated heparin. Of the 152 adverse reactions the researchers studied, 98.5 percent occurred in facilities that received tainted heparin.

The study also shows that the patients' reactions were consistent with the biological reaction provoked by the contaminant. In an earlier NEJM study, Sasisekharan and others showed that OSCS activates two inflammatory pathways, causing severe allergic reactions and low blood pressure.

The new results provide a critical link between the illnesses and the contaminant, Sasisekharan said.

"It's one thing to show that OSCS is able to activate inflammatory responses and is thereby capable of causing adverse events in humans, but ultimately the epidemiological study is necessary to establish that correlation," he said.

"Sasisekharan's development of a technique to detect oversulfated chondroitin sulfate rapidly led to the establishment of a clear link between the contaminant and the adverse reactions," said Jeremy M. Berg, director of the NIH's National Institute of General Medical Sciences, which partially supported the work. "This demonstrates the importance of analytical methods in contributing to the safety of medications."

The team also included researchers from the FDA, the CDC, Brigham and Women's Hospital and Harvard Medical School, St. Louis Children's Hospital, BJC Healthcare, Momenta Pharmaceuticals and the Missouri Department of Health and Senior Services.

PHOTO / **JUDITH M. DANIELS**

SA+P Dean Adèle Naudé Santos

SANTOS: SA+P dean wins AIA award

Continued from **Page 1**

founding dean of the UC San Diego School of Architecture and professor of architecture and urban design at the University of Pennsylvania, where she was also chair of the architecture department for six years. She has also taught at Harvard's Graduate School of Design and at Rice, and has held visiting appointments throughout the U.S. and the world, including Italy and in her native South Africa.

As SA+P dean, Santos has recruited a whole new generation of leaders in all the school's major divisions — Yung Ho Chang in the Department of Architecture, Amy Glasmeier in the Department of Urban Studies and Planning, Frank Moss at the Media Lab and Ute Meta Bauer in the Visual Arts Program. Under their leadership, a number of highly distinguished new faculty have been hired throughout the school.

Of her work as dean, Pritzker Prize-winner Fumihiko Maki said, "She dramatically transformed the school by creating synergy between architecture, urban design, media arts and sciences while appointing senior positions to an international cast of educators-cum-practitioners. It has culminated in a renewed interest in research where a new and evolving curriculum has emerged."

In addition to her academic work, Santos is principal architect in the San Francisco-based firm, Santos Prescott and Associates. Her architectural and planning projects include affordable and luxury housing and institutional buildings in Africa; affordable housing in Japan; the Institute of Contemporary Art in Philadelphia; the Center for the Arts at Albright College, Reading, Pa.; the Yerba Buena Gardens Children's Center in San Francisco; City Links, a vision plan for San Diego; and Franklin/LaBrea Affordable Housing in Hollywood, Calif.

According to the AIA, her practice is known for its holistic approach, and her academic work for its interdisciplinary attitude. "During my entire career," Santos said, "I have combined teaching and practice. There has always been a cross-fertilization between the two, and, at their best, both teaching and practice have been a form of research. The balance between the two has been an important stimulus to my creativity as a teacher and to my professional work and role as an administrator. Even now, as dean at MIT, I have a small practice, which I find an essential creative outlet, and I continue to teach."

Santos holds an AA from the Architectural Association in London and a Master of Architecture in urban design from Harvard, as well as a Master of Architecture and a Master of City Planning from the University of Pennsylvania. She has won an impressive number of awards and competitions all over the world, six of them first-place finishes.

This is the second time the Topaz Medallion has come to MIT; in 2004, the award was given to Stanford Anderson, then head of the Department of Architecture and now professor of history, theory and criticism in the department.

Santos will receive her medallion in March at the annual meeting of the Association of Collegiate Schools of Architecture and will be honored by the AIA at its convention later in the spring.

MIT wins prestigious award for Kerberos work

MIT has been awarded the Mellon Award for Technology Collaboration in recognition of the Institute's 20 years of work on developing and supporting Kerberos, the world's most widely used authentication system for computer networks.

Vinton Cerf, chief evangelist at Google and one of the original pioneers of the Internet, presented the award on behalf of the Andrew W. Mellon Foundation during a Dec. 8 ceremony in Washington.

"MIT's contribution of Kerberos to the higher-education community may rank as the most successful such donation in history," Cerf said. "Kerberos is used hundreds of millions of times daily, in all Windows computers and thousands of higher-education institutions worldwide. In selecting MIT for this award for Kerberos, our committee noted MIT's long-term support of the project, as well as their exemplary record of supporting others who wish to use Kerberos."

Kerberos was invented in the 1980s as part of Project Athena, led by Professor Steven Lerman, now MIT's vice chancellor and dean for graduate education, and by Professor Emeritus Jerry Saltzer, and has been maintained and expanded by the team in Information Services and Technology under Vice President Jerrold Grochow.

In 2007, MIT formed the Kerberos Consortium and charged it with the mission of establishing Kerberos as the universal authentication system for the world's computer networks. The consortium now includes 20 Founding Sponsors, including Apple, Google, Microsoft, Sun, the Department of Defense, NASA, other corporate organizations, and 10 other universities. Stephen C. Buckley serves as executive director.

The Kerberos Consortium will use the $100,000 in award proceeds toward further improving the interoperability of Kerberos across a multiplicity of platforms and devices.

The Mellon Award for Technology Collaboration comes in two levels, $50,000 and $100,000. Winners of the $100,000 awards are chosen for having distinguished themselves by demonstrating extraordinary leadership, usually over an extended period of time, of one or more projects.

This year, two institutions received $100,000 awards, while nine received $50,000.

SFS launches search for new executive director

Dean for Undergraduate Education Daniel Hastings has announced a national search for a new executive director of Student Financial Services (SFS). The search committee will be led by Duane Boning, professor of electrical engineering and computer science, with the following faculty, staff and student members:

- Mary Callahan, registrar
- Steve Graves, the Abraham Siegel Professor of Management in the MIT Sloan School of Management
- Christine Meholic, director, Student and Administrative Information Systems
- Allysa Piché, senior, Sloan School of Management
- Stuart Schmill, dean of admissions
- Israel Ruiz, vice president for finance
- Rosalind Williams, the Bern Dibner Professor of the History of Science and Technology

Community members are encouraged to share suggestions and thoughts on this search with committee members.

Betsy Hicks, the former SFS executive director, was recently named associate vice president of student administrative services and university registrar at Columbia University.

Consultant Jim Hess from Opus Partners Inc. has been retained to aid in the search. Interested candidates should contact: Opus Search Partners Inc., 1616 Walnut St., Suite 1812, Philadelphia, PA 19103; 215-790-1188 or jim.hess@opuspartners.net.

SMART

SMART UROP

The Singapore-MIT Alliance for Research and Technology (SMART) is pleased to sponsor paid summer undergraduate research opportunities in Singapore. This research opportunity will enable undergraduates to participate in an MIT's faculty member's Singapore research project and, through an international experience be exposed to a foreign culture and interact with students and faculty from diverse backgrounds. Each undergraduate will have an MIT faculty member as a mentor/supervisor and conduct research within the faculty member's Singapore research program. The undergraduate will have access and use of the faculty's laboratory and equipment.

Eligibility:

MIT undergraduates in good standing who have already or will have successfully completed their first year are eligible to apply.

Requirements:

Applicants should contact an MIT faculty member participating in the SMART program (refer to http://web.mit.edu/smart/ to view the list of faculty participants) and based upon interaction with that faculty member, submit an application that contains:

- A 1-3 page description of the research that you would like to conduct in Singapore.
- A recommendation from the MIT faculty.
- An indication of your supervisor(s) while in Singapore (faculty member, staff, graduate students).
- The period you propose to spend in Singapore, in general not less than two (2) months.
- Upon your return to MIT two evaluations: one from you faculty supervisor and the other from you. The faculty evaluation should assess your progress and inform us about your contributions to the research program. Your evaluation should describe the progress of your research project, both accomplishments and challenges, as well as an assessment of your academic and personal experience in Singapore.

Compensation:

- Hourly rate of US$10.00 per hour
- Roundtrip economy class airfare
- US$25.00 per diem per day (food and transportation)
- Accommodations

Applications:

Applications should be submitted by March 1ST to Jocelyn Sales at jsales@mit.edu.

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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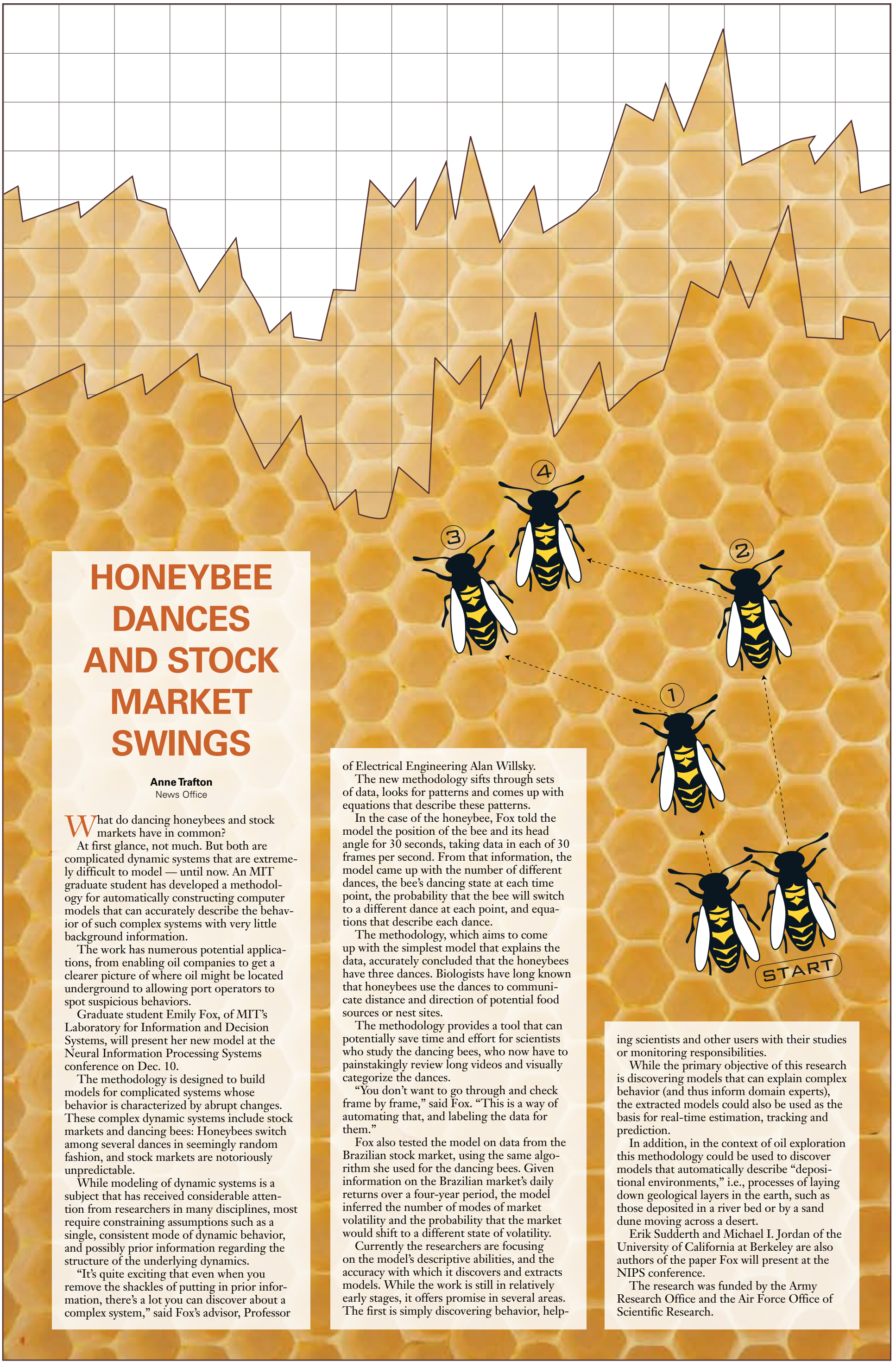

HONEYBEE DANCES AND STOCK MARKET SWINGS

Anne Trafton
News Office

What do dancing honeybees and stock markets have in common?

At first glance, not much. But both are complicated dynamic systems that are extremely difficult to model — until now. An MIT graduate student has developed a methodology for automatically constructing computer models that can accurately describe the behavior of such complex systems with very little background information.

The work has numerous potential applications, from enabling oil companies to get a clearer picture of where oil might be located underground to allowing port operators to spot suspicious behaviors.

Graduate student Emily Fox, of MIT's Laboratory for Information and Decision Systems, will present her new model at the Neural Information Processing Systems conference on Dec. 10.

The methodology is designed to build models for complicated systems whose behavior is characterized by abrupt changes. These complex dynamic systems include stock markets and dancing bees: Honeybees switch among several dances in seemingly random fashion, and stock markets are notoriously unpredictable.

While modeling of dynamic systems is a subject that has received considerable attention from researchers in many disciplines, most require constraining assumptions such as a single, consistent mode of dynamic behavior, and possibly prior information regarding the structure of the underlying dynamics.

"It's quite exciting that even when you remove the shackles of putting in prior information, there's a lot you can discover about a complex system," said Fox's advisor, Professor of Electrical Engineering Alan Willsky.

The new methodology sifts through sets of data, looks for patterns and comes up with equations that describe these patterns.

In the case of the honeybee, Fox told the model the position of the bee and its head angle for 30 seconds, taking data in each of 30 frames per second. From that information, the model came up with the number of different dances, the bee's dancing state at each time point, the probability that the bee will switch to a different dance at each point, and equations that describe each dance.

The methodology, which aims to come up with the simplest model that explains the data, accurately concluded that the honeybees have three dances. Biologists have long known that honeybees use the dances to communicate distance and direction of potential food sources or nest sites.

The methodology provides a tool that can potentially save time and effort for scientists who study the dancing bees, who now have to painstakingly review long videos and visually categorize the dances.

"You don't want to go through and check frame by frame," said Fox. "This is a way of automating that, and labeling the data for them."

Fox also tested the model on data from the Brazilian stock market, using the same algorithm she used for the dancing bees. Given information on the Brazilian market's daily returns over a four-year period, the model inferred the number of modes of market volatility and the probability that the market would shift to a different state of volatility.

Currently the researchers are focusing on the model's descriptive abilities, and the accuracy with which it discovers and extracts models. While the work is still in relatively early stages, it offers promise in several areas. The first is simply discovering behavior, helping scientists and other users with their studies or monitoring responsibilities.

While the primary objective of this research is discovering models that can explain complex behavior (and thus inform domain experts), the extracted models could also be used as the basis for real-time estimation, tracking and prediction.

In addition, in the context of oil exploration this methodology could be used to discover models that automatically describe "depositional environments," i.e., processes of laying down geological layers in the earth, such as those deposited in a river bed or by a sand dune moving across a desert.

Erik Sudderth and Michael I. Jordan of the University of California at Berkeley are also authors of the paper Fox will present at the NIPS conference.

The research was funded by the Army Research Office and the Air Force Office of Scientific Research.

ILLUSTRATION / REBECCA MACRI