

# Caltech 336

T F S S M T W T F S S M T W

The campus community biweekly

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## Fun under the clouds



Overcast skies didn't dampen the spirits of an enthusiastic group that gathered for the annual Gradiators competition on October 16. Postponed from its usual summertime slot, this year's event included the traditional wacky games, relays, and barbecue for grad students, their families, and friends.

## Campus under construction

If there were such a thing as a fifth season, at Caltech it would be the beginning of construction season, with the forecast calling for heavy machinery and major renovations. Expect advanced research facilities, a slew of modern offices, and a windfall of 700 new parking spaces.

The person in charge of these major multimillion-dollar projects is Art Elbert, Caltech's associate vice president for campus planning. After only two years on the job, Elbert was recently handed another hat to wear, that of acting vice president for business and finance, taking over from the departing Al Horvath.

"It's going fine because the staff is so well-qualified," Elbert says of the transition, sounding surprisingly cheerful despite the recent deluge of responsibilities. "We have a very good staff and the leadership has been very supportive."

In the month since his appointment, Elbert has met with many of the staff members at Institute Finance, Human Resources, the Administrative Technology Center, Audit Services and Institute Compliance, and Sponsored Research. He now oversees 650 employees distributed in about a dozen offices.

A native of Pittsburgh, Pennsylvania, Elbert has spent more than 30 years in a variety of administrative positions at the

University of Oklahoma and more recently at Cal State Northridge. There, Elbert played a crucial role in rebuilding the university's structures damaged by the powerful 1994 Northridge earthquake.

Elbert recently took a breather to sit down to speak about the various projects and capital improvements in store for the coming years.

"I just recently made an appointment of Bonnie Khang-Keating to direct the Architectural and Engineering Services," he says. "She's taking over the management of most of the projects." These range from the construction of new structures from scratch to the renovation of existing yet aging buildings.

The new parking structure south of California Boulevard: "The project is going very well though a little behind schedule," Elbert says of the 700-space, \$16.3 million underground structure.

"Caltech's Master Plan requires that we construct a new parking garage before we build the Astrophysics Center," he says. "It's going to be completed soon after the new year."

Before breaking ground, planners had hoped to install a tank adjacent to the lot, part of a thermal energy storage system to provide the campus with cheap and

see *Construction*, page 6

## Artists unveil their works

With the opening of Pasadena's Tender Land festival on October 9, Caltech and the Art Center College of Design's Williamson Gallery have launched three collaborative art installations—two of them, by Lita Albuquerque and Michael McMillen, here on campus.

Albuquerque's lifelong interest in science—particularly the sky—together with the late Caltech physicist Willy Fowler's nucleosynthesis theory, inspired *Stellar Mapping I*, just south of Avery House. In 1957, Fowler coauthored a seminal paper showing that the nuclear processes of stars, starting out with just the hydrogen and helium produced by the Big Bang, could synthesize all the chemical elements. He later shared the 1983 Nobel Prize in physics for that work.

"The most extraordinary advances are being made in physics and astrophysics," Albuquerque says. Also piquing her interest has been the increasing convergence of art and science in recent years, which she believes has taken scientific discovery to the philosophical level. "It's about us and who we are."

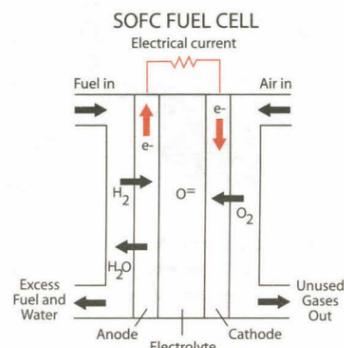
*Stellar Mapping I* represents these themes in what Albuquerque describes as both a mapping and a "sculptural interpretation of a mad scientist lab having discovered IRS (interstellar remnants) from the explosion of a supernova." Set on a round platform surrounded by a moat of crushed glass, handblown glass bell jars are placed in the position of the stars in the constellation Lupus, believed to have been the location of a historic supernova that took place in AD 1006. Inside the jars are brightly colored minerals—red, white, cobalt blue, gold—signifying the products of the star's explosion.

Like the late artist Yves Klein, who as a young man "claimed" the sky, Albuquerque has claimed the relationship between sky and earth as a foundational theme. Much of her art has examined this connection, including another piece in Sacramento involving the nucleosynthesis theory, on which she consulted with astronomers.

Albuquerque has been "absolutely thrilled" to collaborate with scientists, see *Artists*, page 6

## Flu shot update

Because the flu vaccine is in short supply this year, Caltech has been able to obtain just a small quantity. Inoculations will be available only for campus community members who are age 65 and over, have an underlying chronic medical condition, or are pregnant. The clinic will be on Wednesday, October 27, from 9 a.m. to noon in the Winnett lounge. A Caltech ID is required.



## Fuel cells: the next generation

For several years now the Department of Energy (DOE) has been urging the fuel-cell community to solve a major problem in the design of solid-oxide fuel cells (SOFCs): heat. Such fuel cells could someday provide reliable power for homes and industry, dramatically cutting greenhouse gas emissions and other pollutants.

But SOFCs run hot, at temperatures as high as 1,000 degrees Celsius (about 1,800°F). They're efficient at such temperatures, but only a few costly materials can withstand the heat. Using such materials makes things expensive, and is the reason for DOE's push for lower temperatures.

Sossina Haile, an associate professor of materials science and chemical engineering see *Fuel cells*, page 6

## Memory lane in the brain

Biologist Erin Schuman is interested in how memories are formed—or forgotten. The landscape that the professor of biology at Caltech explores is the hippocampus, the part of the brain known to be crucial for memory in humans and other animals.

In 2002, Schuman and graduate student Miguel Remondes published a paper in the journal *Nature* that suggested a possible role for a well-known but poorly understood part of the brain known as the temporoammonic (TA) pathway. Using rat hippocampus slices, they suggested two possible roles for the TA pathway that were not previously known: to serve as a memory gatekeeper that can either enhance or diminish memories, and to provide information to help animals know where they are in their environments.

The researchers' next step was to prove their theories by looking at a possible role for the TA in memory at a behavioral level.

To understand how memories are formed, many scientists have focused on the "trisynaptic circuit," which involves three areas of the hippocampus: input from the senses is first sent from the cortex to the dentate gyrus, where this signal is processed by two sets of synapses, then sent back to the cortex. That's the circuit. An often-overlooked separate input to the hippocampus, though, is the see *Brain*, page 6

# NewsBriefs



Food vendors descended on the Winnett patio last week with free samples, urging nibbling Techers to tell Dining Services which delicacies they want to have available on campus.

## Personals

### Welcome to Caltech

#### September

**Andrea Boyle**, administrative assistant, engineering and applied science; **Adolfo Gaona**, switchboard operator, Administrative Technology Center; **Alexey Goldin**, staff scientist, physics, mathematics and astronomy; **Pin Wang**, scientific researcher, chemistry and chemical engineering.

**Houman Owhadi** joined Caltech as an assistant professor of applied and computational mathematics and control and dynamical systems effective September 1. His research focuses particularly on the development of methods for analyzing systems where a continuum of spatial or temporal scales is required to capture a system's essential physics, and his interests extend to a variety of application areas. He received his BS from Ecole Polytechnique in 1994, his MS from Ecole Nationale des Ponts et Chaussées in 1997, and his PhD from Ecole Polytechnique Fédéral de Lausanne in 2001.

#### October

**Allison Artiaga**, server, and **Rickey Butler**, general helper/dishwasher, both in Dining Services; **Lehong Chow**, assistant animal lab technician, biology; **Raul Climatianos**, associate, desktop support, Information Technology Services; **Ian Foe**, research technician, biology; **Anne Gladman**, assistant to the director and to the associate director, Student-Faculty Programs Office; **Lucy Hammond** and **Robert Kim**, both servers in Dining Services; **Zhiming Kuang**, researcher, planetary sciences; **Kimberley Mawhinney**, senior business systems consultant, Administrative Technology Center; **Jonas Oxgaard**, director of applied quantum and catalysis technology, chemistry and chemical engineering; **Tim Pyle**, multimedia engineer, physics, mathematics and astronomy; **Lazaro Torres**, custodian, Facilities Management; **Marie Vu**, senior business systems consultant, Administrative Technology Center; **Hong Yu**, research technician, biology.

**Dan Tabata** joined Caltech's Electronic Media Publications on October 4 as system administrator. He had been working with EMP as a contractor since 2003. His responsibilities will include desktop support, server administration, and special projects.

#### November

**John O'Doherty** joins Caltech effective November 1 as assistant professor of psychology. Widely published in a variety of journals, he is noted for his expertise in functional magnetic resonance imaging (fMRI) techniques and for his computational skills, which provide a bridge between neuroscience and economics. He received his BA from the University of Dublin in 1996 and his DPhil from the University of Oxford in 2000.

### New positions

**Federico Echenique** has been named associate professor of economics, effective November 1. Echenique received his master's degree from Universidad de la Republica, Uruguay, in 1995 and his PhD from UC Berkeley in 2000. He joined Caltech as an instructor in 2002 and was appointed assistant professor June 2004.

### Retirements

**Susan Leising**, a member of the support staff for the library system, retired on October 15. She had worked at Caltech for 14 years.

## Honors and awards

**Susan Davis**, division administrator for the Humanities and Social Sciences, has been elected to a three-year term as a member of the Los Angeles Urban League's board of directors. Founded 82 years ago, the organization provides aid and services to diverse constituencies in both the city of Los Angeles and throughout the greater region.

**Stephen Quake**, Everhart Professor of Applied Physics and Physics and currently on leave at Stanford University, has been named by the National Institutes of Health (NIH) as one of nine recipients of the first annual Director's Pioneer Award. The award will provide Quake, who works in the areas of biophysics and bioengineering, with \$2.5 million for the next five years as part of the NIH's new "Roadmap for Medical Research" program. He received his BS from Stanford in 1991 and his doctorate from the University of Oxford in 1994. He joined Caltech as an assistant professor in 1996, became full professor in 2003, and was named Everhart Professor in 2004.

**Re'em Sari**, associate professor of astrophysics and planetary science, has been awarded a David and Lucile Packard Fellowship for Science and Engineering. Paid over a five-year period, the fellowships were established in 1988 by the David and Lucile Packard Foundation "to allow the nation's most promising professors to pursue science and engineering research early in their careers with few funding restrictions and limited paperwork requirements." After receiving his PhD from Hebrew University in 1998, Sari came to Caltech as a Fairchild Senior Research Fellow in Astrophysics that same year. He was appointed associate professor in 2003.

**Alexander Varshavsky**, Smits Professor of Cell Biology, has been named corecipient of the Protein Society's 2005 Stein and Moore Award. Presented annually, the award recognizes the "revolutionary work" of Varshavsky and Avram Hershko, Distinguished Professor at the Technion—Israel Institute of Technology, "in discovering the ubiquitin system of protein degradation, its mechanisms, and its significance to living cells." Smits Professor at Caltech since 1992, Varshavsky earned his BS from Moscow State University in 1970 and his PhD from the Institute of Molecular Biology in 1973.



## Goodstein in the spotlight

The next Research Spotlight for staff members, presented by Business and Finance, will take place Tuesday, November 2, at 11 a.m. in the Beckman Institute auditorium. David Goodstein, Caltech vice provost and professor of physics and applied physics, will discuss his latest book, *Out of Gas: The End of the Age of Oil*.

According to Sue McHugh, Business and Finance outreach coordinator, the spotlights are intended to build bridges between faculty and staff by helping staff better understand the Institute's mission and the wide variety of its research.

"The Research Spotlights are specifically geared toward staff who might not have the opportunity to learn about faculty research through other means, like attending evening Watson Lectures," she says. Goodstein recently opened the 2004–05 season of that lecture series with a similar talk.

Seating will be first come, first served; no tickets are required. For more information, visit [www.businessandfinance.caltech.edu](http://www.businessandfinance.caltech.edu).

## Grad to survey dance worldwide

Iram Bilal, who graduated with honors in engineering and applied science last June, is the recipient of a Thomas J. Watson Fellowship, which will fund her project "Dance: Language of Emotion or Culture?"

Whether performed to a pounding rhythm or demure minuet, dance is a phenomenon of cultures around the world. What inspires dance? Why is it so universal? Is it something we want to do or need to do? Beginning her explorations this fall in India, Bilal will research temple dancing. She will then visit Kenya to witness tribal dancing, and finally Ireland, where she will investigate social and folk dancing. She will document her findings with photography, oral interviews, videotaping, and writing.

The Thomas J. Watson Foundation provides grants to graduating college seniors for one-year independent-study projects. The program encourages participants to pursue a passion and undertake a coveted "once-in-a-lifetime" project for which they might otherwise never have the opportunity.

Bilal received numerous honors and awards during her career at Caltech, including the Mabel Beckman Prize for academic excellence and leadership, and the Caltech Deans' Cup for leadership and community involvement. She was active in the Society of Women Engineers, the Caltech Entrepreneurial Club, the Caltech Y, and the Organization of Associated Students from the Indian Subcontinent.

Originally from Islamabad, Pakistan, Bilal has trained in classical South Indian odissi dancing and enjoys choreography, martial arts, painting, acting, and debating. She hopes someday to combine her love of science, the arts, and multiculturalism by becoming a documentary arts and sciences filmmaker and producer.

## Round two of SIF proposals awarded

In a quest for innovative programs that further the goals of Business and Finance (BF), the Strategic Initiatives Fund (SIF) committee has funded a second group of proposals. Committee members presented the newest awards at a recent meeting of leaders of the Roadmap to Success program, of which the SIF—a \$50,000 fund to implement ideas from Business and Finance staff at all levels—is a part.

The first awards were made in September to Ruth Whitson (Accounting Services) and Rainbow Lee (Institute Finance), who created a plan to improve communications between BF and the campus via focus groups and teamwork training sessions, and to Gaylin Laughlin, Linda Hodges, and Lynn Theriault (all of Audit Services) for an idea to help BF staff better understand others' roles by having them "walk in each other's footsteps" for a day.

In round two, the committee awarded funds for four proposals submitted by eight staff: Darren Artura (Treasurer's Office), Elsa Echegaray (Transportation Services), and Bill Irwin (Facilities Management), who each submitted similar ideas to make surplus campus equipment available for sale to the Caltech community; Luana Lovato (Worker's Compensation), for a plan to improve employee awareness of campus wellness programs, which currently are all advertised separately by the sponsoring offices; David Mispagel (Architectural and Engineering Services), who suggested a yearbook that would serve as an overview of BF and unite the various offices in a common project; and Elsa Echegaray, Tina Lai (International Student Programs), and Steve Shu (Administrative Technology Center [ATC]), who proposed making rideshare information more available to employees and promoting use of the Gold Line.

Proposals were evaluated for measurable benefits, financial savings or generation, and broad applicability across the unit; ideas anticipating a "quick win" also gained a slight edge over long-term plans. SIF committee coordinator and ATC staffer Doris Shimabukuro said more than 40 proposals were received, illustrating "the abundance of creative ideas that we can tap into" to help BF fulfill its vision.

Representing a cross section of Business and Finance, the 2004–05 committee also includes Mispagel, Bob Carter (Employee Relations), Tracey Fraser (Financial Services), Marisu Jimenez (Athenaeum), Michelle Lin (ATC), Tina Lowenthal (Procurement Services), Reza Ohadi (Central Plant), David Mayo (Sponsored Research), Tye Welch (Audit and Institute Compliance), and David Wertz (ATC).

## Bookstore celebrates Halloween

Get your most frightfully clever outfit ready for the Caltech Bookstore's annual Halloween costume contest on Friday, October 29. More details will be posted soon at [www.bookstore.caltech.edu](http://www.bookstore.caltech.edu). You might even find parts of your costume in the bookstore's recently arrived stock of spooky merchandise. Store hours are Monday to Friday, 8:30 a.m. to 6 p.m.

# October 25–October 31, 2004

M T W T F S S

## Monday, October 25

### Thesis Seminar

106 Spalding Lab, Hartley Memorial Seminar Room, 10 a.m.—“Global Distribution, Radiative Forcing, and Climate Impact of Carbonaceous Aerosols,” Serena Chung, graduate student in chemical engineering, Caltech.

### Edward B. Lewis Memorial

Beckman Auditorium, 2 p.m.—A reception in Dabney Gardens will follow the memorial. If you are planning to attend, please send a message to Laura Rodriguez ([laurar@caltech.edu](mailto:laurar@caltech.edu)). Donations in Professor Lewis’s memory may be made to the Huntington Medical Research Institutes, 734 Fairmount Avenue, Pasadena, CA 91105.

### Geological and Planetary Sciences Seminar

155 Arms, Robert Sharp Lecture Hall, 4 p.m.—“Chemical Composition of the Upper Mantle,” Rhea Workman, graduate student in geology and geophysics, Woods Hole Oceanographic Institution.

### High Energy Physics Seminar

469 Lauritsen, 4 p.m.—“X(3872) as a Loosely Bound Molecule,” Masaaki Kusunoki, department of physics, Ohio State University. Information: [www.theory.caltech.edu/people/carol/seminar.html](http://www.theory.caltech.edu/people/carol/seminar.html).

### USGS Special Event

Beckman Institute auditorium, 8 p.m.—“Wildfires + Rain = Debris Flows,” Susan Cannon, geologist, U.S. Geological Survey. Information: <http://pasadena.wr.usgs.gov/info/lectures/index.html>.

## Tuesday, October 26

### LIGO Science Seminar

351 West Bridge, LIGO Science Conference Room, 11 a.m.—“GEO600: Where Are We?,” Hartmut Grote, Max Planck Institute for Gravitational Physics (Albert Einstein Institute). Information: [www.ligo.caltech.edu/LIGO\\_web/seminars/science\\_seminars/next.html](http://www.ligo.caltech.edu/LIGO_web/seminars/science_seminars/next.html).

### Mathematical Physics Seminar

351 Sloan, noon—“Zeros of Random Orthogonal Polynomials on the Unit Circle,” Mihai Stoiciu, graduate student in mathematics, Caltech. Information: [www.math.caltech.edu/events/mathphys.html](http://www.math.caltech.edu/events/mathphys.html).

### Carnegie Observatories Colloquium Series

William T. Golden Auditorium, 813 Santa Barbara Street, 4 p.m.—“Simulations of Jets Driven by Black Hole Rotation,” Brian Punsly, Boeing. Refreshments, 3:30 p.m.

### High Energy Physics Seminar

248 Lauritsen, 4 p.m.—“A Measurement of the Unitarity Triangle Angle Gamma,” Justin Albert, postdoctoral scholar in physics, Caltech.

### Robert P. Sharp Memorial

Athenaeum, 4 p.m.—A reception will follow the memorial. Donations in Dr. Sharp’s memory may be made by writing to the Robert P. Sharp Ventures in Earth Sciences Fund, GPS Division, attention Marcia Hudson, MC 170-25, Pasadena, CA 91125. Checks should be made payable to Caltech, with a notation indicating a gift for the memorial fund.

## Wednesday, October 27

### Doctoral Examination

151 Crellin, 3:15 to 4:30 p.m.—Elizabeth Borths. Committee: Bjorkman (chair), Chan, Fraser, Rees, and Matt Welch (UC Berkeley). Thesis: Structural and Biochemical Characterization of the Vitamin B12 ABC Transporter, BtuCD-F.

### Environmental Science and Engineering Seminar

142 Keck, 3:40 to 5 p.m.—“What Controls the Carbon Cycle Over Geologic Time?,” Daniel Schrag, professor of geochemistry and director, Laboratory for Geochemical Oceanography, department of earth and planetary sciences, Harvard University. Information: [www.ese.caltech.edu/seminars/index.html](http://www.ese.caltech.edu/seminars/index.html).

### Astronomy Colloquium

155 Arms, Robert Sharp Lecture Hall, 4 p.m.—Topic to be announced. Carolyn Porco, adjunct professor, department of planetary sciences and Lunar and Planetary Laboratory, University of Arizona and University of Colorado at Boulder, and senior research scientist, Space Science Institute, Boulder, Colorado. Information: [www.astro.caltech.edu/~gma/colloquia.html](http://www.astro.caltech.edu/~gma/colloquia.html).

### Earnest C. Watson Lecture Series

Beckman Auditorium, 8 p.m.—“How Flies Fly,” Michael Dickinson, Zarem Professor of Bioengineering, Caltech. Admission is free. Information: 395-4652, 1 (888) 2CALTECH, or [events@caltech.edu](mailto:events@caltech.edu). Individuals with a disability: 395-4688 (voice) or 395-3700 (TDD). Visit Public Events at [www.events.caltech.edu](http://www.events.caltech.edu).

## Thursday, October 28

### CSEM Annual Meeting

Avery Library, 8 a.m. to 6 p.m.—The keynote speaker will be Angela Belcher, MIT, recent recipient of a MacArthur “genius” fellowship. Other talks will include research advances in bulk metallic glasses and composites, biological structure-function relationships in macromolecular materials, precise polyolefin synthesis, and thermoelectric materials, featuring presentations by Caltech faculty who are world leaders in these research areas. Registration: [www.csem.caltech.edu/annrev/index.html](http://www.csem.caltech.edu/annrev/index.html).

### Arnold O. Beckman Memorial

Beckman Auditorium, 4 p.m.—A reception in Glanville Courtyard of the Beckman Institute will follow the memorial. Donations in Dr. Beckman’s memory may be made to the Beckman Young Investigators Fund, c/o the Arnold and Mabel Beckman Foundation, 100 Academy Drive, Irvine, CA 92612.

### Bioengineering Seminar Series

142 Keck, 4 p.m.—“Mechanisms of the Initial Stages of Gallstone Formation,” Daphne Weihs, departments of pathology and chemistry, David Geffen School of Medicine, UCLA. Information: [www.be.caltech.edu/seminars.html](http://www.be.caltech.edu/seminars.html).

### Molecular, Cellular, and Developmental Biology Seminar

119 Kerckhoff, 4 p.m.—“Genetic Analysis of Dopaminergic and Noradrenergic Systems Development in Zebrafish,” Professor Wolfgang Driever, department of biology, University of Freiburg, Germany.

### Physics Research Conference

201 E. Bridge, 4 p.m.—“Kinematics and Dark Energy from Supernovae at  $z > 1$ ,” Dr. Adam Riess, Space Telescope Science Institute (STScI). Refreshments, 114 E. Bridge, 3:45 p.m.

## Friday, October 29

### High Energy Theory Seminar

469 Lauritsen, 11 a.m.—“From One-Loop Effective Actions to the Background Geometry,” Alexander Gorsky, Institute for Theoretical and Experimental Physics (ITEP), Moscow. Information: [www.theory.caltech.edu/people/seminar/schedule.html](http://www.theory.caltech.edu/people/seminar/schedule.html).

### High Energy Theory Seminar

469 Lauritsen, 1 p.m.—Topic to be announced. David Mateos, postdoctoral fellow, Perimeter Institute. Information: [www.theory.caltech.edu/people/seminar/schedule.html](http://www.theory.caltech.edu/people/seminar/schedule.html).

### Memorial Service for J. Beverley Oke

Athenaeum, 2 p.m.—The memorial service will take place in the Athenaeum’s main lounge. A reception will follow the service.

### Fall Meeting on Mathematics in Industry

Baxter Lecture Hall, 2:30 to 4 p.m.—“Trustworthy Electronic Election Results without Trusted Machines,” Andy Neff, chief scientist, Votehere.com. Information: [www.its.caltech.edu/~siam](http://www.its.caltech.edu/~siam).

### History and Philosophy of Science Seminar

Treasure Room, Dabney Hall, 4 p.m.—“Mount Wilson Observatory and Dutch Astronomy: The Legacy of Jacobus Kapteyn (1851–1922),” Professor Klaas van Berkel, history department, University of Groningen.

### Kellogg Seminar

Lauritsen Library, 4 p.m.—“The Milagro Experiment,” Professor Gaurang Yodh, department of physics and astronomy, UC Irvine.

# November 1–7, 2004

M T W T F S S

## Monday, November 1

### Geological and Planetary Sciences Seminar

155 Arms, Robert Sharp Lecture Hall, 4 p.m.—“The Nitrogen and Oxygen Isotopes of Nitrate in the Ocean: Basic Systematics and an Application in the Eastern North Pacific,” Daniel Sigman, assistant professor, department of geosciences, Princeton.

### High Energy Physics Seminar

469 Lauritsen, 4 p.m.—“How Eternal Inflation Can Explain the Second Law of Thermodynamics,” Professor Sean Carroll, physics department, University of Chicago. Information: [www.theory.caltech.edu/people/carol/seminar.html](http://www.theory.caltech.edu/people/carol/seminar.html).

### Inorganic-Electrochemistry Seminar

147 Noyes, Sturdivant Lecture Hall, 4 p.m.—“Rational Chemical Strategies for Carbon Nanotube Functionalization,” Professor Stanislaus Wong, department of chemistry, State University of New York at Stony Brook.

### Molecular, Cellular, and Developmental Biology Seminar

119 Kerckhoff, 4 p.m.—Topic to be announced. Elaine Bearer, department of pathology and Laboratory of Medicine, Brown University.

### Sloan-Swartz Center for Theoretical Neurobiology Seminar

24 Beckman Labs, 4 p.m.—“Mechanisms of Visual Associative Processing,” Professor Reinhard Eckhorn, neurophysics group, Philipps University, Marburg, Germany.

### Applied Mathematics Colloquium

101 Guggenheim Lab, Lees-Kubota Lecture Hall, 4:15 p.m.—“Exact and Practical Ways to Unfold a Data Manifold,” Matthew Brand, ERL, Mitsubishi.

## Tuesday, November 2

### Chemical Physics Seminar

147 Noyes, Sturdivant Lecture Hall, 4 p.m.—“Dynamics and Energetics of CH<sub>4</sub> and NH<sub>3</sub> Activation at Size-Selected Transition Metal Clusters,” Peter Armentrout, Distinguished Professor, department of chemistry, University of Utah.

### General Biology Seminar

119 Kerckhoff, 4 p.m.—Topic to be announced. Professor Steven Reiner, department of medicine, Abramson Family Cancer Research Institute, University of Pennsylvania.

## Wednesday, November 3

### 2004 JPL Research and Technology Development Poster Session

JPL, 8 a.m. to 4 p.m.—This JPL research and technology development poster session will present the results of 110 principal investigators in the R&TD program. At 11:30 a.m., JPL’s director, Charles Elachi, will speak on how the future success of JPL is directly tied to its internal investment in new and enhanced science and technology capabilities. Taking place in JPL’s von Karman Auditorium and on the JPL Mall, the event is open to Caltech faculty, staff, and students. Refreshments.

### Environmental Science and Engineering Seminar

142 Keck, 3:40 to 5 p.m.—“Large-Scale Ocean Circulation: A Heat Budget Perspective,” Giulio Boccaletti, postdoctoral associate, department of earth, atmospheric, and planetary sciences, MIT. Information: [www.ese.caltech.edu/seminars/index.html](http://www.ese.caltech.edu/seminars/index.html).

### Astronomy Colloquium

155 Arms, Robert Sharp Lecture Hall, 4 p.m.—Topic to be announced. Professor George H. Rieke, astronomer and deputy director of the Steward Observatory, University of Arizona. Information: [www.astro.caltech.edu/~gma/colloquia.html](http://www.astro.caltech.edu/~gma/colloquia.html).

### Information Science and Technology Seminar

080 Moore, 4 p.m.—“Geometric Algorithms for Placement Problems in Sensor Networks,” Professor Alon Efrat, department of computer science, University of Arizona.

### Organic Chemistry Seminar

153 Noyes, Sturdivant Lecture Hall, 4 p.m.—“Chemical Synthesis and Synthetic Biology,” Professor Dirk Trauner, department of chemistry, UC Berkeley.

## Thursday, November 4

### Caltech Library System Presents: Quick Review for Electronic Theses

Sherman Fairchild Library, multimedia conference room, 2 to 3:30 p.m.—A brief overview of techniques useful in the production and publication of Caltech electronic theses. The session will include tips on formatting, intellectual-property considerations, paper to pixels, creating PDFs, submitting a thesis, and availability issues (who can see it and when). No reservations required. Information: <http://library.caltech.edu/learning/default.htm>.

### Chemical Physics Seminar

147 Noyes, Sturdivant Lecture Hall, 4 p.m.—“Attosecond Science,” Professor Paul Corkum, Steacie Institute for Molecular Sciences, National Research Council Canada.

### Constantin G. Economou Memorial Lecture

106 Spalding Lab, Hartley Memorial Seminar Room, 4 p.m.—“Single Particle Motion in Colloidal Suspensions as a Paradigm for Nonlinear Microrheology,” Aditya Khair, graduate student in chemical engineering, Caltech. Refreshments, 113 Spalding Lab, 3:30 p.m. Information: [www.che.caltech.edu/calendar/seminars.html](http://www.che.caltech.edu/calendar/seminars.html).

### Physics Research Conference

201 E. Bridge, 4 p.m.—“Gravity Probe B: Testing Einstein in Space—A Marriage of Physics and Technology,” Professor C. W. Francis Everitt, Hansen Experimental Physics Laboratory, department of physics, Stanford University. Refreshments, 114 E. Bridge, 3:45 p.m.

## Friday, November 5

### High Energy Theory Seminar

469 Lauritsen, 11 a.m.—Topic to be announced. Sebastian Franco, MIT. Information: [www.theory.caltech.edu/people/seminar/schedule.html](http://www.theory.caltech.edu/people/seminar/schedule.html).

### High Energy Theory Seminar

469 Lauritsen, 1 p.m.—Topic to be announced. Oleg Lunin, Institute for Advanced Study. Information: [www.theory.caltech.edu/people/seminar/schedule.html](http://www.theory.caltech.edu/people/seminar/schedule.html).

### Chemical Engineering Seminar

106 Spalding Lab, Hartley Memorial Seminar Room, 4 p.m.—“Structure and Rheology of Random Foam,” Andrew Kraynik, Sandia National Laboratories.

### History and Philosophy of Science Seminar

Treasure Room, Dabney Hall, 4 p.m.—“Shifting Ontologies in Eighteenth-Century Chemistry: Classification Between Workshop, Laboratory, and the Field,” Wolfgang Lefevre and Ursula Klein, Max Planck Institute for the History of Science, Berlin.

### Inorganic-Organometallics Seminar

151 Crellin, 4 p.m.—“DNA-Mediated Charge Transfer: A Mechanism for Damage Detection in DNA Repair,” Amie Boal, graduate student in chemistry, Caltech.

### Kellogg Seminar

Lauritsen Library, 4 p.m.—“La Sapienza,” Omar Benhar, INFN, University of Rome.

### German Language Film Series

Baxter Lecture Hall, 7:30 to 10 p.m.—*Die Schweizermacher (The Swissmakers)* (1978), Switzerland; with English subtitles.

# CampusEvents

## Monday, October 25

### East Coast Swing Class

Winnett lounge, 7:30 p.m.—Learn East Coast swing with a professional instructor. This is the fourth class in a five-week series. Fee: Caltech students, \$6 per class; others, \$8 per class. No partner or experience required.

## Tuesday, October 26

### CIT Knitters Group Meeting

256 Mudd Laboratory, South, noon—All levels of knitters and related handcrafters are welcome. We make items for others and ourselves. Information: 395-6699 or 395-6905.

### English as a Second Language (ESL)

115 Beckman Institute, 4 to 6 p.m.—A review of basic English grammar to enhance listening, speaking, reading, and writing skills. This class will meet on Tuesdays and Thursdays for eight weeks. Registration: 395-8055 or diane.williams@caltech.edu. Information: [http://cit.hr.caltech.edu/Education/super&non\\_super/esl.htm](http://cit.hr.caltech.edu/Education/super&non_super/esl.htm).

### Volleyball

at Occidental College, 7:30 p.m.

## Wednesday, October 27

### Men's Soccer

vs. University of Redlands, 4 p.m.

### Salsa Dance Classes

Winnett lounge, 7 p.m.—Learn the fundamentals of salsa dancing starting at 8:30 p.m. If you already know the basics, come to the intermediate class at 7 p.m. and learn Cuban rueda. Classes started on October 6. Cost: \$7 for a single class, five classes for \$25.

## Thursday, October 28

### Motivation Workshop for Supervisors and Nonsupervisors

Brown Gym classroom, 8:30 a.m. to 12:30 p.m.—This workshop will show you ways to become a self-motivator and to inspire others while maintaining the energy, drive, and enthusiasm that elicits staff cooperation and achieves results. Registration: 395-8055 or diane.williams@caltech.edu. Information: [http://cit.hr.caltech.edu/Education/super&non\\_super/motivation.htm](http://cit.hr.caltech.edu/Education/super&non_super/motivation.htm).

### Caltech Architectural Tour

Athenaeum, 11 a.m. to 12:30 p.m.—Meet in the entry hall of the Athenaeum. Led by members of the Caltech Architectural Tour Service, a special service of the Caltech Women's Club. Reservations: Susan Lee, 395-6327 or suze@caltech.edu.

### GSC Underrepresented Students Committee

Red Door Café, 5 p.m.—Meetings are open to members of the Caltech community. Information: gscus@its.

### Amnesty International Monthly Meeting

Caltech Y lounge, 7:30 p.m.—Caltech/Pasadena AI Group 22 holds its monthly meeting to discuss current activities and plans. All are welcome. Refreshments. Information: (818) 354-4461 or lkamp@lively.jpl.nasa.gov. Visit our website at [www.its.caltech.edu/~aigp22](http://www.its.caltech.edu/~aigp22).

### Intermediate International-Style Ballroom Dance Class

Winnett lounge, 8 p.m.—This is the fourth class in an eight-week series. The first hour will cover standard ballroom and the second will feature the Latin style.

## Friday, October 29

### PERT: Disaster Preparation and Triage

200 Broad Center, 8 to 10 a.m.—Pasadena Emergency Response Training (PERT) will consist of three sessions: Disaster Preparation and Triage, Fire Suppression, and Disaster Search and Rescue. This is the first of the three sessions, and all three sessions are required. You must have a current First-Aid/CPR/AED to enroll. Offered in conjunction with the Pasadena Fire Department, Caltech Safety Office, and American Red Cross. Registration: 395-6727 or [safety.training@caltech.edu](mailto:safety.training@caltech.edu).

### Volleyball

vs. Pomona-Pitzer College, 7:30 p.m.

### The Passing Zone

Beckman Auditorium, 8 p.m.—Take two guys with chainsaws, put them in tights, throw in a Garden Weasel, and what do you get? Jugglers Owen Morse and Jon Wee make juggling both funny and hip. (See Public Events contact information on this page.)

## Saturday, October 30

### Cross Country

SCIAC Championships, at Prado Park, Chino, 9 a.m.

### Men's Soccer

vs. Occidental College, 11 a.m.

### Belly-Dancing Classes

Braun Gym, multipurpose room, 12:45 p.m.—Learn to belly dance with Leela, a popular performer and instructor. Fee for trial class: \$5 for Caltech students, \$8 for others. Fee for full 8-week series: \$20 for Caltech students, \$50 for other Caltech community members.

### Volleyball

at University of La Verne, 2 p.m.

### Walking with Dinosaurs

Beckman Auditorium, 2 p.m.—Using leading-edge computer technology and animatronics, the Emmy Award-winning film *Walking with Dinosaurs* lets us travel back in time to watch living, breathing dinosaurs in their natural habitat. Suitable for ages 6 and older. (See Public Events contact information on this page.)

## Sunday, October 31

### Beginning International-Style Ballroom Dance Class

Winnett lounge, 4:30 p.m.—This is the fourth class in an eight-week series. No partner or previous experience is required.

## Monday, November 1

### Women's Club Welcoming Coffee

JPL, von Karman Auditorium, 11 a.m. to 1 p.m.—An opportunity to meet new friends, welcome newcomers, and learn more about the Caltech Women's Club.

### East Coast Swing Class

Winnett lounge, 7:30 p.m.—Learn East Coast swing with a professional instructor. This is the last class in a five-week series. No partner or experience is required.

## Tuesday, November 2

### Project Management: An Approach

Brown Gym classroom, 8:30 a.m. to 4:30 p.m.—This class, for supervisors and nonsupervisors, will present methods to streamline project planning and management. Registration: 395-8055 or diane.williams@caltech.edu. Information: [http://cit.hr.caltech.edu/Education/super&non\\_super/project\\_approach.htm](http://cit.hr.caltech.edu/Education/super&non_super/project_approach.htm).

### "Watch Your Back!" Back Safety Training

118 Keith Spalding Building, 8:30 a.m.—This course includes a brief discussion on back anatomy and proper methods and realistic approaches to handling and moving materials. There will be a video presentation and hands-on lifting. Space is limited. Please call 395-6727 or e-mail [safety.training@caltech.edu](mailto:safety.training@caltech.edu) to reserve a place.

### Volleyball

at Whittier College, 7:30 p.m.

## Wednesday, November 3

### Men's Soccer

at Pomona-Pitzer College, 2:30 p.m.

### CPA Board of Directors Monthly Meeting

Avery Courtyard, 4 p.m.—The Caltech Postdoctoral Association board meets once a month. Meetings are open to the Caltech community.

### Salsa Dance Classes

See Wednesday, October 27, for details.

## Thursday, November 4

### Volleyball

at University of Redlands, 7:30 p.m.

### Intermediate International-Style Ballroom Dance Class

See Thursday, October 28, for details.

### Voices of Vision Series: "Everything Bad Is Good for You"

Beckman Auditorium, 8 p.m.—Techno-cultural historian Steven Johnson is a contributing editor for *Wired* and *Discovery* magazines, the editor-in-chief of the Internet magazine *FEED*, and the author of the award-winning books *Interface Culture*; *Emergence: The Connected Lives of Ants, Brains, Cities, and Software*; and, most recently, *Mind Wide Open: Your Brain and the Neuroscience of Everyday Life*. Admission is free.

## Friday, November 5

### PERT Training: Fire Suppression

200 Broad Center, 8 to 10 a.m.—Fire suppression is the second of three required sessions of PERT (Pasadena Emergency Response Training). You must have a current First Aid/CPR/AED to take this training. Offered in conjunction with the Pasadena Fire Department, Caltech Safety Office, and American Red Cross. Information: 395-6727 or [safety.training@caltech.edu](mailto:safety.training@caltech.edu).

### Men's Soccer

vs. Chapman University, 2:30 p.m.

### The Misanthrope

Dabney Lounge, 8 p.m.—Theater Arts at Caltech presents Molière's satiric play. (See Public Events contact information on this page.)

## Saturday, November 6

### Parents' Day

Beckman Institute courtyard and auditorium and the Athenaeum, 9 a.m. to 4 p.m.—This event is for the parents of new students. Reservations are required. Registration: 395-6351 or [machang@caltech.edu](mailto:machang@caltech.edu).

### Planning for Your Child's Educational Future

Verdugo Hills Hospital, 1812 Verdugo Blvd, Glendale, 4th Floor Council Room, 10 a.m. to noon—Effective ways for parents to develop a financial plan for their child's college education will be presented by David Levy, Caltech's director of financial aid, and Catherine Thomas, of USC's financial aid office. Hosted by the Child Educational Center and the Verdugo Hills Hospital Foundation, this program is free. Continental breakfast, 9:45 a.m. Information and reservations: (818) 354-3418.

### Belly-Dancing Classes

See Saturday, October 30, for details.

### Becket, or The Honor of God: L.A. Theatre Works

Ramo Auditorium, 8 p.m.—Tony Award-winning actor Denis O'Hare stars as St. Thomas Becket in Jean Anouilh's play *Becket, or The Honor of God*. Presented by L.A. Theatre Works. (See Public Events contact information on this page.)

### The Misanthrope

Dabney Lounge, 8 p.m.—Theater Arts at Caltech presents Molière's satiric play. (See Public Events contact information on this page.)

## Sunday, November 7

### The Misanthrope

Dabney Lounge, 2 p.m.—Theater Arts at Caltech presents Molière's satiric play. (See Public Events contact information on this page.)

### Coleman Chamber Concert

Beckman Auditorium, 3:30 p.m.—The chamber group Sequenza will perform works by Debussy, Ravel, and Beethoven. (See Public Events contact information on this page.)

### Beginning International-Style Ballroom Dance Class

See Sunday, October 31, for details.

## Ongoing events

### Tuesdays

#### Preschool Playgroup

Tournament Park, 10 a.m. to noon—Song and storytime, crafts and free play for toddlers and preschoolers (from walking to age 4). Information: 584-0970 or [kimdeman@yahoo.com](mailto:kimdeman@yahoo.com).

#### Caltech Shorinji Kempo Club

Brown Gymnasium, 7 p.m.—Learn effective self-defense and martial arts. Sessions are free. No experience required. Wear comfortable clothing.

#### Caltech Tai Chi Club

Winnett lounge, 7 p.m.—Meets Tuesdays and Fridays weekly. Sessions are free. Information: [www.its.caltech.edu/~taichi](http://www.its.caltech.edu/~taichi).

#### Ballroom Team Practice

Braun Gym, multipurpose room, 9 p.m.—Ballroom team practice is held each Tuesday. Sessions feature the assistance of a professional coach so that team members can get advice and tips to improve their dancing. Team membership is required, and there is a \$5 fee to enter the gym if you do not have Caltech/JPL ID.

### Wednesdays

#### Wednesdays in the Park

Tournament Park, 10 a.m. to noon—Every Wednesday there's conversation and coffee for parents and caregivers, and playtime and snacks for children. Stop by and make new friends from around the world. Information: 793-2535 or [nancyhewett@earthlink.net](mailto:nancyhewett@earthlink.net).

### Thursdays

#### Caltech Baby Furniture and Household Equipment Pool

234 S. Catalina, 10 a.m. to 1 p.m.—Loans of kitchen and household necessities and baby furniture are made to members of the Caltech and JPL communities. Open on Thursdays from 10 a.m. to 1 p.m. No appointment is necessary. Information: 584-9773. [furnpool@caltech.edu](mailto:furnpool@caltech.edu).

#### Caltech Shorinji Kempo Club

Brown Gymnasium, 7 p.m.—Learn effective self-defense and martial arts. Sessions are free. No experience required. Wear comfortable clothing.

### Fridays

#### Caltech Tai Chi Club

Winnett lounge, 7 p.m.—Meets Tuesdays and Fridays weekly. Sessions are free. Information: [www.its.caltech.edu/~taichi](http://www.its.caltech.edu/~taichi).

#### Caltech Chess Club

Page House dining room, 8 p.m.—Be you master or novice, you will enjoy the chess club's weekly meetings. Information: <http://www.its.caltech.edu/~citchess>.

### Sundays

#### Caltech Shorinji Kempo

Braun Athletic Center, aerobics room, 3:30 p.m.—Learn effective self-defense and martial arts. Sessions are free. No experience required. Wear comfortable clothing.

## Public Events information and tickets

395-4652, 1 (888) 2CALTECH, or [events@caltech.edu](mailto:events@caltech.edu). Individuals with a disability: 395-4688 (voice) or 395-3700 (TDD). Visit Public Events at [www.events.caltech.edu](http://www.events.caltech.edu).

**Construction, from page 1**

plentiful chilled water during the summer. However, Elbert says, factors such as the rising cost of natural gas and an extended payback period made the project unfeasible. The funds were reassigned to the dormitory renovation.

Dabney Hall: "It's my first big project," he says with satisfaction. "We completed the renovation over the summer and Humanities has moved in." The tab added up to about \$7.6 million.

Cahill Center for Astronomy and Astrophysics: Plans call for the structure, which will be designed by acclaimed Santa Monica architect and urban planner Thom Mayne, to sit on California Boulevard, supplanting the parking lot adjacent to Keith Spalding.

"The project is estimated at \$45 million," Elbert says. "It's one of our three major activities for the coming year." The other two are the South Undergraduate Houses and the Center for Information Science and Technology.

South Undergraduate Houses: "This is an upgrade of all the mechanical and electrical systems, including the air conditioning system, and bringing them up to current codes," Elbert says of Blacker, Dabney, Fleming, and Ricketts. "Construction will begin in June of '05 and will continue for about 15 months. They will be ready for students in the fall of '06."

In the meantime, students will be housed in trailers, about 16 of which will be parked in the lot north of the Holliston parking structure and four or five in the field north of Avery Center.

Chandler Dining Hall: "We're renovating Chandler in order to have a place for the students to eat while we renovate the South Houses," Elbert says. The renovation includes a covered extension of the north side of the dining hall and serving area. Work began earlier this month, and is expected to be completed in the spring.

Center for Information Science and Technology: This building is envisioned as a home base for centers with a common focus of study—information. It will bring the Center for the Physics of Information, the Center for Biological Circuit Design, the Social and Information Sciences Laboratory, and the Center for the Mathematics of Information together with the Lee Center for Advanced Networking and the Center for Neuromorphic Systems Engineering.

"The building will be situated in the area south of Avery Center and east of Moore Laboratory, and it has a summer of '07 completion date," Elbert says. Architects are being interviewed, and once an appointment is made, the design process is estimated to take about a year.

Kavli Nanoscience Institute: "The renovation of Steele Laboratory will add offices and laboratory space for use by at least four divisions in the new KNI," Elbert says.

The institute will foster innovative research at the frontiers of nanoscale science and engineering. Work on the \$8 million institute will be largely funded by a grant from Fred Kavli and the Moorpark-based Kavli Foundation.

St. Luke Medical Center: Although it is not a site of major construction, the former hospital and campus, now known as CIT<sup>2</sup>, house a center dedicated to the design of the world's largest telescope.

"We bought it a little over a year ago, and we're generating enough income to cover most of our operating costs through rentals and filming," Elbert says. "We are in the process of rebuilding the convent to provide quarters for the Thirty Meter Telescope project, and we anticipate that it will be completed after the end of the year."

**Artists, from page 1**

and hopes to continue—she plans to work with Caltech researchers on the Pole Project ([www.poleproject.com](http://www.poleproject.com)), an ambitious installation set for 2006–07 that will project a star-map reflection onto the ice at the North and South Poles.

McMillen says his artwork, *Dr. Crump's Inductive Geo-Imaging Field Laboratory*, is an homage to the "industrial, Art Deco look" of the Flash Gordon and Buck Rogers flicks he loved as a kid. Situated just east of Throop Pond, the lab—"the strange little world of this never-seen scientist"—has a vintage look, with pale green and cream colors and subtle architectural touches, such as porthole



Top: *Stellar Mapping I*. Bottom: *Dr. Crump's Inductive Geo-Imaging Field Laboratory*.

**The Joey connection**

Viewers of the television comedy *Friends* know that the character Joey Tribbiani left New York as the series ended, and that he landed in Hollywood, a move that resulted in a spin-off called *Joey*. What they may have missed is that Joey's California nephew Michael is attending Caltech.

While Joey the aspiring actor is a bit of a mental midget, Michael the graduate student is a certified genius; and while Joey is a gifted skirt-chaser, Michael is a novice at love, and so on. This dichotomy is milked for laughs, especially when Joey gives Michael an education in picking up women. This dynamic also allows Joey (Matt LeBlanc) to play father figure to Michael (Paulo Costanzo), who lives at home with his mother Gina (Drea de Matteo), Joey's brassy sister.

*Joey* is broadcast locally on Thursdays at 8 p.m. on KNBC.

windows and an arched ceiling that gives a sense of spaciousness. (The lab's location is fitting, as one of McMillen's early brushes with Caltech was as a sculptor and moldmaker creating artificial boulders for Throop Pond's construction in the '70s.)

The installation is a work in progress, says McMillen. Visitors won't glimpse the "very, very shy" Crump, who's developed a proprietary technology—a kind of underground radar that can image what lies beneath the earth's surface. Over the months, however, curiosity seekers who enter the trailer will see an ever-increasing stockpile of results and artifacts from the good doctor's research.

When asked about what inspired *Dr. Crump*, McMillen, who is also serving as Caltech's artist in residence, replies, "Lots of times you ask questions like 'What if?' and 'Why not?'" In answer, as in other works such as *The Garage* (at the Los Angeles County Museum of Art), he has tried to create a situation that takes viewers out of the present to a different time and place. "I'm curious to see what the response will be," McMillen says, adding with a smile, "You never know—the world is full of surprises."

At the Williamson Gallery (1700 Lida Street, Pasadena) is *ear(th)*, by artist Steve Roden in collaboration with Caltech professor Joel Burdick, grad student Ann Marie Polsenberg, and associate professor Mark Simons. With the researchers' input, Roden has created a giant "sculptural installation/musical instrument that will be 'played' by data retrieved from technologies tracking earth forces."

All three works will be on display through April 9. For more information on the Tender Land festival, visit <http://tenderland.org>.

**Brain, from page 1**

TA pathway. It makes direct contact with the neurons that are at the last station in the trisynaptic circuit, thus short-circuiting the traditional trisynaptic pathway.

Reporting in the October 7 issue of *Nature*, Remondes and Schuman, who is also an associate investigator for the Howard Hughes Medical Institute, now show they were correct in their belief that the TA pathway is important in spatial or location memory.

The scientists used rats in experiments that tested their short-term and long-term memories.

"These data indicate there must be a dialogue between the hippocampus and the cortex during long-term memory consolidation," Schuman says. "Clearly, the TA pathway plays an important role in this discussion." Further, she notes, "understanding the mechanisms of memory formation and retention may shed light on diseases like Alzheimer's, where memory is impaired."

The full text of this article may be viewed online at [http://pr.caltech.edu/media/Press\\_Releases/PR12593.html](http://pr.caltech.edu/media/Press_Releases/PR12593.html).

**Fuel cells, from page 1**

at Caltech, is an expert in fuel cells, and she has been whittling away at the heat problem for years. Now she and her colleagues have not only solved the problem, they've smashed it. They've brought the temperature down to about 600°C (1,100°F), while achieving more power output than others are achieving at the higher temperatures—about 1 watt per square centimeter of fuel-cell area.

They accomplished this by changing the chemical composition of one component of a fuel cell called the cathode. The cathode is where air is fed into the fuel cell, and it's where the oxygen is electrochemically reduced to oxygen ions. The oxygen ions then migrate across the electrolyte (which conducts electricity), to react with fuel at the anode, another fuel-cell component. The electrochemical reduction of oxygen is an essential step in the fuel cell's process of generating power. But the problem with running solid-oxide fuel cells at 500 to 700°C is that the cathode becomes inactive when the temperature is less than about 800°C.

Haile and postdoctoral scholar Zongping Shao's insight was to switch out the conventional cathode and replace it with a compound, abbreviated as BSCF, that allows oxygen to diffuse through it very rapidly. This is what helps give the very high power outputs from Haile's fuel cells. Haile's next step may be to partner with a company to produce the next generation of solid-oxide fuel cells.

The full text of this article may be viewed online at [http://pr.caltech.edu/media/Press\\_Releases/PR12600.html](http://pr.caltech.edu/media/Press_Releases/PR12600.html).

**Caltech 336**

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