inside physics

From the Chair

There has been much excitement in the Physics Department over the last year, starting with the announcement last October of a Nobel Prize to David Gross, the Frederick W. Gluck Professor of Theoretical Physics and Director of the Kavli Institute for Theoretical Physics. This is the third Nobel awarded to a Department faculty member in the past seven years. Overall, awards and outside recognition for our faculty continue at a gratifying pace. Among them is the election of Joe Polchinski to the National Academy of Sciences, bringing the number of NAS members in the Department to nine. More are highlighted within these pages.

Recent Physics faculty arrivals are Tommaso Treu, an observational astrophysicist who works on understanding the formation and evolution of galaxies, and Wim van Dam, a member of the Computer Science Department who also holds a partial appointment in Physics. Wim studies quantum computing and quantum information theory. We also welcome back Mike Witherell, who left the Department in 1999 to become Director of Fermilab, and now returns to UCSB as Vice Chancellor for Research and as a Physics faculty member. Our efforts to ensure that the Department remains at the very highest levels in research and teaching continue with faculty searches in mathematical physics (to be a joint appointment with Mathematics), condensed matter theory, and biophysics. These are exciting times across the spectrum of disciplines in our science, and we strive to maintain and enhance our contributions to it.

The number of applicants to our graduate program continues to rise. We had well over 500 last year, a new record, and now welcome an entering class of 37. This is an unusually large number for us, and reflects a sharp and noteworthy increase in the fraction of those admitted who made UCSB their final choice. It also poses significant financial challenges that we are striving to meet.

Our undergraduate program is also strong, with nearly 200 students (in both the College of Letters and Science and the College of Creative Studies) who have chosen to major in Physics. Last year, we were able to set aside some space for an undergraduate student lounge, "The End of the Universe". To complement this facility, we have relocated and completely refurbished the Physics Study Room, where our undergraduates can get together for cooperative work, and where our graduate Teaching Assistants hold office hours.

We struggle to find space to accommodate the many research and teaching programs in our venerable building, Broida Hall. Last year, Broida received its first new coat of paint in its forty year existence, and we recently completed a renovation of the main lobby with some new paint and flooring (replacing the mismatched bits of linoleum that had accumulated over the decades) and new display cases where we will showcase posters depicting some of our most exciting research areas. Looking forward, we hope to move towards construction of a state-of-the-art facility to supplement Broida in the not-too-distant future, but this will again pose significant challenges in the current UC and California fiscal climate.

Finally, you might notice a new signature on this missive. This past summer, Jim Allen completed five years as our Chair, and the Departmental reins were handed over to me; Beth Gwinn is my successor as Vice Chair. On behalf of all the faculty, staff, students, and friends of the Physics Department, Beth and I would like to thank Jim for the unparalleled vision and leadership he gave us during his time as Chair. Going forward, we hope to prove worthy of the trust the Department has placed in us.

Mark Srednicki
Department Chair
UCSB Physics

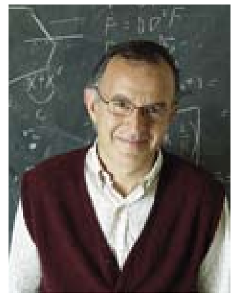
Faculty News

Appointments

Wim van Dam joined the Department of Physics this summer as an Assistant Professor. In Fall 2004, Wim became an Assistant Professor at UCSB's Department of Computer Science, but his current shared appointment between Computer Science and Physics better reflects Wim's current research, which focuses on the theory of quantum computing. His main interest lies in the development of new quantum algorithms that solve problems exponentially faster than we know how to do using traditional, classical computers. Such efficient quantum algorithms are already known to exist for certain computational problems in number theory, thus making a functioning quantum computer capable of breaking almost all cryptographic protocols. One of the main challenges in the field of quantum computing is to understand better which other hard problems are amenable to an efficient quantum solution, and which are not. Wim has made several important contributions to this quest.

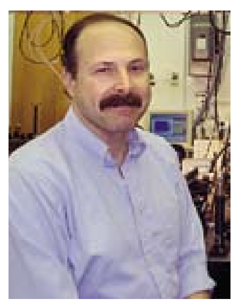
Wim received his Ph.D. in Physics from the University of Oxford, UK (2000) and a Ph.D. in Computer Science from the University of Amsterdam, The Netherlands (2002). Before joining UCSB in July 2004, he was a postdoc at the Computer Science Division of UC Berkeley, HP Labs Palo Alto, The Mathematical Sciences Research Institute, and MIT's Center for Theoretical Physics.

Tommaso Treu joined the department in the spring of 2005 as an Assistant Professor. After obtaining undergraduate degrees from the University of Pisa and the Scuola Normale Superiore (Italy) in 1998, he received his Ph.D. in Physics from the Scuola Normale Superiore in 2001. During his graduate studies he spent half of his time at the Space Telescope Science Institute working with the Hubble Space Telescope. He was then a postdoc at Caltech until September of 2003, and a Hubble Fellow at UCLA until he arrived at UCSB. Tommaso's research is in the field of observational cosmology, with specific interests in galaxy formation, clusters of galaxies, gravitational lensing, and supermassive black-holes. He uses Hubble and other NASA satellites as well as the UC-operated Keck and Lick telescopes to conduct his observations.



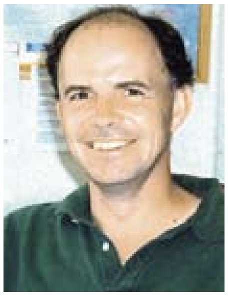
Boris Shraiman is a new professor in the Department of Physics and a permanent member of the Kavli Institute for Theoretical Physics. His current research interests are focused on quantitative systems biology, where he studies physical mechanisms of growth control in the development of limbs and organs, as well as statistical mechanics approaches to comparative genomics and evolution. Boris received his Ph.D. in Physics from Harvard in 1983, and did postdoctoral work at U. of Chicago and AT&T Bell Labs. In 1987 he became a member of Technical Staff in the Theoretical Physics department at Bell Labs, where he remained until 2002 when he became a professor of Physics at Rutgers University. Shraiman joined UCSB in the summer of 2004.

Awards & Honors

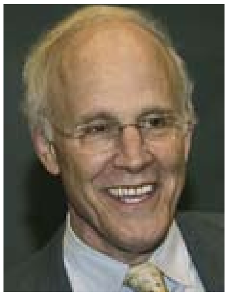


David Awschalom was a joint recipient of the 2005 Agilent Europhysics Prize for Outstanding Achievement in Condensed Matter Physics by The European Physical Society (EPS) for his investigations of magnetic semiconductors and spin coherence in the solid state, which has paved the way for the emergence of spin electronics, or "spintronics." The Europhysics Prize is one of the most prestigious honors given by the EPS, with eight past awardees subsequently winning the Nobel Prize. With a cash award of 51,000 Swiss francs, the prize recognizes scientific excellence and focuses on work that advances the fields of electronic, electrical and materials engineering.David also received the prestigious Oliver E. Buckley Prize in 2005. The Buckley Prize is given annually by the American Physical Society, leaders in the international physics community, to recognize and encourage outstanding theoretical or experimental contributions to condensed matter physics. The prize was endowed in 1952 by AT&T Bell Laboratories (now Lucent Technologies) to recognize outstanding scientific work. It is named in memory of Oliver E. Buckley, a past president of Bell Labs. Only 70 other scientists have received the award, and 13 of them have gone on to win a Nobel Prize. In presenting the award, APS cited David's "fundamental contributions to experimental studies of quantum spin dynamics and spin coherence in condensed matter systems."

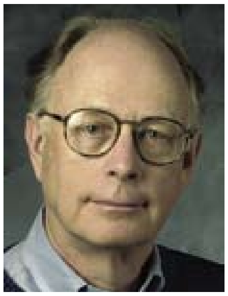
"We're enormously proud of David Awschalom," said Martin Moskovits, dean of the Division of Mathematical, Life and Physical Sciences. "David and his coworkers are pioneer founders of a new branch of physics dubbed 'spintronics,' which exploits a previously underused property-a kind of fundamental magnetism-of the familiar particle of electricity, the electron. This magnetism could be harnessed to create a whole new technology for carrying out computation, communication and control. This accomplishment could, one day, rank alongside the discovery of the transistor in its impact."



Andrew Cleland is part of a team of 25 scientists (5 from UCSB) that has been awarded a $13 million grant to develop ways to use nanotechnologies in the design of new ways to detect, monitor, treat and eliminate vulnerable plaque, the probable cause of death from sudden cardiac arrest. The group will build "delivery vehicles" that can be used to transport drugs, imaging agents and nano-devices directly to locations where there is vulnerable plaque; design molecular nano-stents to physically stabilize vulnerable plaque and replace its fibrous cap with an anti-adhesive, anti-inflammatory surface; devise molecular switches that can sense and respond to the pathophysiology of atheroma (fatty deposits on arterial walls); and develop bio-nanoelectromechanical systems (called BioNEMS) that can sense and respond to vulnerable plaque, ultimately providing diagnostic and therapeutic capability. Said Elizabeth G. Nabel, M.D., director of the National Heart, Lung, and Blood Institute of the NIH, this is a "vitally important research effort that will spur the development of novel technologies to diagnose and treat heart, lung, and blood diseases. The program brings together bioengineers, materials scientists, biologists, and physicians who will work in interdisciplinary teams. By taking advantage of the unique properties of materials at the nanoscale, these teams will devise creative solutions to medical problems.



David J. Gross, Director of the KITP and the Frederick W. Gluck Professor of Theoretical Physics, was awarded the 2004 Nobel Prize in Physics for solving (in 1973) the last great remaining problem of what has since come to be called "the Standard Model" of elementary particles. He shared the prize with Frank Wilczek, a former UCSB faculty member now at MIT, and with H. David Politzer of Caltech, for their work on the nature of the "strong force" that binds quarks into hadrons such as protons and neutrons. Gross and Wilczek (who was Gross' graduate student at the time) and (working independently) Politzer showed that if the forces between quarks were described by "nonabelian gauge theory", then those forces would increase with distance, contrary to the behavior of the other three forces of nature (gravity, electromagnetism, and the "weak force" responsible for certain radioactive decays), all of which decrease with distance. This property, known as "asymptotic freedom," was exactly what was needed to explain a broad class of experimental results. Their work was immediately hailed as a key breakthrough, and the intervening years have brought overwhelming evidence that it is correct. Much as electromagnetism is due to the exchange of photons between charged particles, the strong force is due to the exchange of "nonabelian gauge bosons" (today better known as gluons, because they provide the "glue" that holds hadrons together) between quarks.



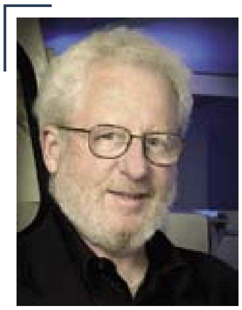
James Hartle was awarded an honorary Doctor of Science degree by The University of Waterloo in fall of 2004 at a special convocation at the Perimeter Institute, which also honored two other scientists, Sir Roger Penrose and Prof. Steven Weinberg. "This special convocation was an opportunity to put a focus on the importance of theoretical or pure research and on these brilliant men who are involved in the ultimate quest for knowledge," said UW President David Johnston. "The University of Waterloo is proud of its strong links with the Perimeter Institute and this special convocation is an excellent way for Waterloo, which is also known for its strong science and physics programs, to play a role in celebrating scientific inquiry and the Perimeter Institute's public opening." The special convocation of 200 invited guests included scientists, faculty members in the UW's Department of Physics, and Ontario Premier Dalton McGuinty, among other government officials.

Jim is known for his work on quantum mechanics and quantum gravity. His early research made important contributions to the understanding of gravitational waves, relativistic stars and black holes. More recently, his interests have turned to quantum gravity and the foundations of quantum mechanics. His 1983 paper with noted physicist Stephen Hawking, "Wave Function of the Universe," is renowned, and the Hartle-Hawking wave function is a commonplace nomenclature among researchers and students of gravitational physics. A mentor to many young scientists, he is widely heralded for both his teaching and his publications.

Harry Nelson shared in the European Physics Society High Energy and Particle Physics Prize for 2005. Harry was a member of the prize-winning NA31 Collaboration at CERN, the European Organization for Nuclear Research in Geneva, which showed for the first time direct time reversal violation in the decays of neutral K mesons. The phenomenon of time reversal violation was discovered unexpectedly in 1964; James Cronin and Val Fitch shared the Nobel Prize in 1980 for that discovery. The NA31 experiment indicated that incorporation of time reversal violation into the Standard Model of particle physics was accurate, and that time reversal violation did not arise from new physics outside the Standard Model. It is widely thought that the time reversal violation in the Standard Model is related to the mechanism whereby the observable universe came to be made mostly of matter, and not anti-matter.

The prize was awarded on July 25, 2005, at the start of the plenary sessions for the International Europhysics Conference on High Energy Physics, HEP2005, in Lisbon. Heinrich Wahl, formerly of CERN, accepted on behalf of the collaboration; he also personally received one-half of the prize for his leadership of time reversal violation experiments. The collaboration assembled at CERN on October 27, 2005 to commemorate the award. The EPS High Energy and Particle Physics Prize has been awarded since 1989, and six of the fifteen prior recipients, including UCSB's David Gross, have gone on to be awarded the Nobel Prize in Physics.

Paul Hansma was elected a fellow of the Institute of Physics in November 2004. Paul has pioneered the development of Atomic Force Microscopes (AFMs), particularly in biological research, for which he received the APS's Biological Physics Prize in 2000. AFMs are used in thousands of labs all over the world. Now, while pioneering high-speed and video-rate AFMs to follow biological processes in real time, his group performs cutting-edge research on the molecular mechanisms of bone fracture. From the beginning, they quickly attained recognition for their work in publications such as *Nature*, *Bone*, and others. Their recent discovery of a very tough natural glue in bone, in collaboration with Dan Morse's (MCDB) and Galen Stucky's (Chemistry) groups, was featured on the cover of the August 2005 issue of *Nature Materials*. Paul holds over 20 patents and has over 300 publications.



Alan Heeger received an honorary Doctor of Science degree from Trinity College, Dublin, on July 8, 2005. At the ceremony, the following citation was read: "Our first candidate is an American scientist of world-wide renown, Alan Jay Heeger, the highly distinguished holder of the Chair of Science and Materials at the University of California, Santa Barbara. He has established there a notable center for the formation and investigation of Advanced Materials consisting of semiconducting and metallic polymers. He has also been instrumental in founding the Uniax Corporation, an engineering and electronic vehicle for the development and application of these products for medicinal and pharmaceutical use. These operations he has conducted with such skill and brilliance that in 2000 he was awarded the Nobel Prize in Chemistry.

His intellectual endowment is matched by the generosity of his disposition, and he has been pleased to welcome our postgraduate students into his laboratories, as well as offering well-judged advice to members of our staff on the appropriate coordination of research between different departments. His own penetrating investigations in the realm of physics constitute a very useful exemplar of the value of interdisciplinary cooperation. When international conferences are staged, Dr. Heeger is always a popular choice as keynote speaker, and his recent lecture at the Advanced Materials Symposium, held in this College, delighted the audience with its clarity and power. He enjoys visiting Ireland, and his contacts with Trinity and in the wider circle of Irish academics have made a significant contribution to our country's progress in the natural sciences. You see before you a thinker who has had the courage to pioneer new paths and the ability to extend the boundaries of knowledge. I ask you to show your appreciation of his work with loudly appreciative applause."

Everett Lipman was one of 116 winners nationwide of the prestigious Sloan Research Fellowship from the Alfred P. Sloan Foundation in 2005. He was selected from among hundreds of highly qualified scientists on the basis of his exceptional promise to contribute to the advancement of knowledge. In his research, Everett uses ultra-sensitive light detection to study the assembly and behavior of single biological molecules.

The Sloan Research Fellowships, awarded annually, were established in 1955 to provide support and recognition to early-career scientists and scholars and to enhance the careers of the very best young faculty members in specified fields of science, with the purpose of stimulating fundamental research. The award of $45,000 for a two-year period will be used by Everett for such purposes as equipment, technical assistance, professional travel, trainee support, and other activities related to his research. Because many Sloan Fellows are often in their first appointments and trying to set up laboratories and establish their independent research projects with little or no outside support, this award is regarded as critically important in the careers of promising young scientists.

Joseph Polchinski was elected to The National Academy of Sciences in May 2005, in recognition of his distinguished and continuing achievements in original research.

The National Academy of Sciences is the country's most prestigious scientific organization, and election to membership in the Academy is considered one of the highest honors that can be accorded a U.S. scientist or engineer. A private organization dedicated to the furtherance of science and its use for the general welfare, the Academy was established in 1863 by a Congressional Act of incorporation signed by Abraham Lincoln that calls on the Academy to act as an official adviser to the federal government, upon request, in any matter of science or technology.

Joe Polchinski received his Ph.D. from UC Berkeley in 1980, and went on to research positions at the Stanford Linear Accelerator and Harvard University before serving on the University of Texas faculty. He joined the Physics and KITP faculty at UC Santa Barbara in 1992. His research interests include string theory, particle physics, and all the applications of quantum field theory. The author of a two-volume text on string theory, he has been a recipient of the Alfred P. Sloan Fellowship, and of the American Physical Society and a member of the American Academy of Arts and Sciences.

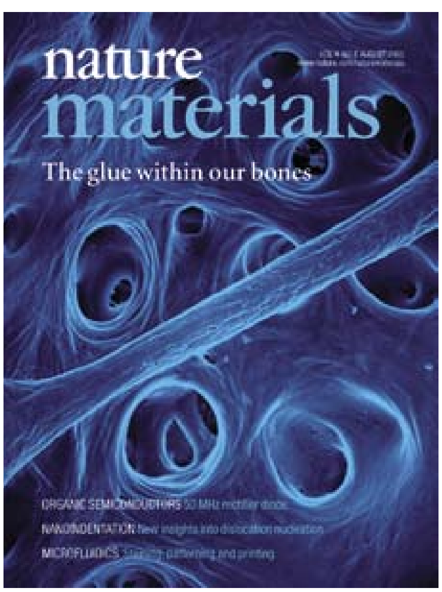
Faculty Focus

Research at the Paul Hansma Group

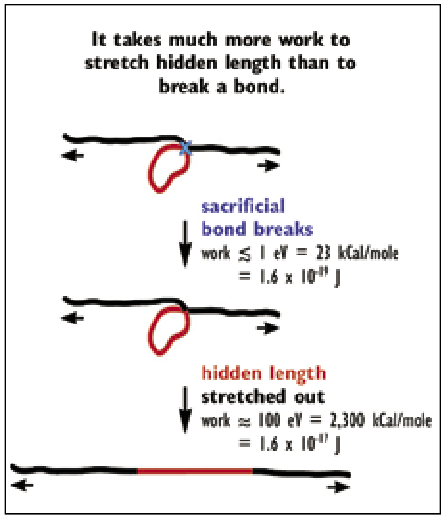
The glue within our bones and other projects

by Simcha Frieda Udwin and Paul Hansma

The Paul Hansma Group, in collaboration with the Dan Morse (Marine Science, MCDB, UCSB) and Galen Stucky (Chemistry, UCSB) Groups, announced a fundamental discovery in the cover article of *Nature Materials* in August 2005: that some proteins in healthy bone critically contribute to the remarkable fracture-resisting materials properties of bone by behaving as a very tough glue with dynamic fracture-resisting properties; in other words, by gluing bone components together both by being inherently sticky and by resisting the constant and varying forces our bones are exposed to by exerting an active attachment mechanism, the sacrificial bond-hidden length mechanism. The discovery that bone proteins have adhesive properties is highly significant because it establishes a more accurate conception of how our bones are structured and therefore why healthy bone is so remarkably fracture-resistant, and also because introduces a component of bone—glue—that has never before been considered in research on bone health, because its existence was not known. Since noncollagenous bone proteins were first studied in the 1960s, they were believed by bone researchers to exist only as agents to mineralize collagen (the primary component of cartilage) into bone.



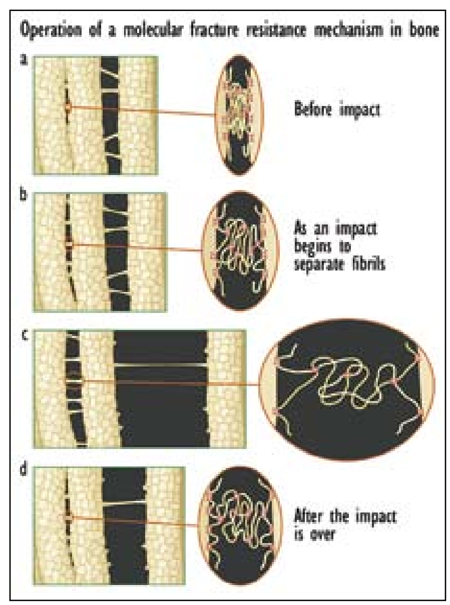
Cover of the recent Nature Materials issue announcing Paul Hansma's group's fundamental discovery of the glue in our bones.



Simplified demonstration of why it's harder to break molecules that contain sacrificial bonds and hidden length. This type of molecule is active in bone glue, and its presence helps explain why that glue makes bone so tough". *Illustration: Dottie McClaren and Paul Hansma*

Bone fracture risk is now estimated and osteoporosis is diagnosed through a radiographic technique that has been developing since the 1940s. Its current form, dual x-ray absorptiometry (DXA), measures bone mineral density (BMD)—a measure of the relative mineral content in an individual patient's bone against a baseline of population values, usually in specific locations where fractures are likeliest to occur, like the lumbar spine and the hip in elderly patients. No technique currently exists to measure the materials properties of bone in a living patient, even though these materials properties, such as fracture toughness, are known to decrease with aging and disease.

The discovery of the glue in bone was presaged with the discovery of glue in another mineralized tissue—abalone shell—by Paul Hansma's group in collaboration with Professors Dan Morse and Galen Stucky (*Nature*, 399: 761-763, 1999). While abalone shell is 97% calcium carbonate, 3% by weight of it is an organic glue, which makes the shell 3,000 times tougher to fracture than pure calcium carbonate!



Schematic of the cumulative effect of bone glue molecules acting together to resist fracture under impacts. *Illustration: Dottie McClaren and Paul Hansma*

As well as being sticky, bone and abalone shell glue is extremely efficient at energy dissipation because it uses the sacrificial bonds and hidden length mechanism. It takes enormous energy to fracture an abalone shell because the protein-based glue between the tiny mineral plates of calcium carbonate holds on even if the spacing between the plates increases from 1 nm to beyond 100 nm. (In human bone, the mineral plates the glue sticks together are made of hydroxyapatite, a calcium phosphate-based compound). The mechanism dissipates large amounts of energy with entropic and enthalpic forces as the tightly bunched hidden length of glue molecules is exposed and stretched after sacrificial bonds break during an impact (please see diagram). And after the glue molecules have been stretched, they can heal themselves.

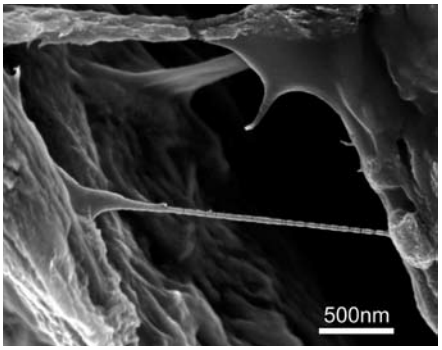
L-R: Zachary Schriock, Frieda Udwin, George Schitter, Johannes Kindt, Shreyas Prasad, Pati Turner, Marquesa Finch, Georg Fantner, Paul Hansma, Philipp Thurner, Blake Erickson (in back), Naushad Khakoo (in front), Jonathan Adams, Alex Lau, Stephanie Lam and Katie Barry. *Photo courtesy of Paul Hansma*

The glue may fail to effectively resist fracture in old age and disease, perhaps because its fracture-resisting mechanism weakens, or there just might be less glue, just as BMD decreases with age and osteoporosis. As a first step to determining what happens to bone glue in aging and disease, Paul's group is now working to precisely ascertain the glue's molecular composition.

The glue discoveries were made possible by seeing the glue in bone and abalone shell at extremely high resolution (down to tens of nanometers) with Atomic Force Microscope (AFM) and Scanning Electron Microscope (SEM) images, and the sacrificial bond-hidden length mechanism was determined by mechanically testing single glue molecules in an AFM stretching technique called single-molecule force spectroscopy. AFMs are especially useful tools in studying biological systems, because not only can they image and manipulate samples at molecular resolution, they do so in physiological, or ambient, conditions - in liquid, and in air if desired. In other microscopy techniques such as SEM, a sample must be placed in high vacuum or under other destructive artificial conditions to be imaged. Paul's group has been the acknowledged world leader in AFM development for the past twenty years, particularly AFM for biological applications.

AFM development continues in parallel with the group's work on bone. The group is working on developing ever faster, high-resolution AFMs to image molecular biological processes as they occur, under natural conditions—in other words, real-time capturing of physiological processes as they unfold.

A main aim of Paul's group's research is to track the effect of molecular fracture dynamics from observations at the molecular scale up to the macroscale. So the group also tests millimeter-sized cubes of bone in a custom-made mechanical tester that is coupled with high-speed, high-resolution photography that reveals how bone fractures in real time. Fracturing bone has never before been imaged in real time. This novel technique reveals mechanisms bone uses when it performs under impact stresses under various conditions and impact speeds.



A Scanning Electron Micrograph of bone glue at the top right-hand corner. *Photo: Georg Fantner.*

Since October last year, Paul and his group have been working on a new instrument to address the fundamental problem of how to measure bone materials properties in living patients. The instrument, named the Osteoprobe, is intended to supplement conventional BMD measurements. It works on the principle that our bones' resistance to microscopic fractures is a good indicator of how resistant our bones are to macroscopic fractures. It works much like a needle; it is designed to be inserted through the skin to a bone surface, to make a microscopic indentation in the bone and to thus measure several materials properties—the response of the bone to this microscopic test gives a measure of its fracture resistance or strength. The instrument has gone through fourteen prototypes and can already successfully distinguish several types of nonliving bone. Its development continues.

Paul Hansma has pioneered the development of Atomic Force Microscopes (AFMs), particularly in biological research, for which he received the APS's Biological Physics Prize in 2000. Elected a fellow of the Institute of Physics in November 2004, he holds over 20 patents and has over 300 publications.

Staff Spotlight

Ride of My Life

by Karen Hurley

This past spring, I had the adventure of a lifetime: an opportunity to ride my bike across the United States. The seven-week, 3,400-mile journey was the most incredible experience of my life; an endurance challenge I will never forget. I rode from Los Angeles to Boston, across fifteen states, with a group called CrossRoads Cycling Adventures. There were about forty riders, ranging in age from twenty-one to seventy-two, originating from various parts of the U.S as well as other countries. Although I was one of the youngest riders, I was the slowest. Seventy-year-olds zoomed past me. I accepted my position at the back of the pack because my goal was to ride the entire 3,400 miles, and it didn't matter how many hours I had to bike every day to accomplish that goal.

We rode an average of 80 miles per day, including several centuries (100 miles or more in one day), through varying wind, weather, and terrain. We biked through deserts, plains, cities, and tiny towns, riding on every type of road imaginable, including interstates, quiet country roads, winding mountain roads, roads with wide shoulders, and roads with no shoulder. I was chased by fifteen dogs, stung by a bee, and threatened by a rattlesnake who didn't appreciate the fact that I nearly rode over its tail. I was pelted with hail, poured on by rain, forced back by headwinds, and scared by thunderstorms and funnel clouds.

The biggest challenge of the adventure was surviving the first week of riding, which included back-to-back centuries through the desert as well as a few days with several long, difficult climbs over steep mountain passes. The most difficult ride, and the most difficult task I've ever completed, was the 116-mile ride from Blythe, California to Wickenburg, Arizona. There were several long, gradual climbs, including false flats, in which the road appeared flat but was actually uphill. I pedaled and pedaled and barely moved forward. I wanted to stop and rest, but I forced myself to keep moving so I wouldn't fall too far behind the rest of the group. The day seemed to get longer and longer. I kept looking at my odometer, hoping the mileage would increase quickly, but the mileage counter seemed to be barely moving. . . because I was barely moving. When the odometer read 70 miles, I knew I had gone a long way, but I still had more than 45 miles to go. It was hot. I had no energy. I stared at the road in front of me, which was completely straight, and I wished it was as flat as it looked. The white line of the shoulder extended as far as my eyes could see, and I wondered why I signed up for such a ride.

The miles slowly ticked away; when I reached 100 miles I felt as if I still had a long way to go. The last six or seven miles were downhill, and I was too tired to pedal so I decided to let gravity do the work nd coast down the hills. When I was within a few miles of the hotel, I noticed something lying on the road, stretched across the shoulder, and at the last second, I realized it was a snake. I swerved, just missing its tail, and the snake coiled up and rattled at me. I guess that wasn't a stick, I thought. After 9.5 hours of riding, I finally reached the hotel, the last to arrive. I had never been so happy to arrive anywhere. I sat at the dinner table that night, half-asleep, and wondered how I would make it through the next day, which included more than 5,500 feet of climbing.

I made it through the next day's ride, and I rode every inch of the 3,400 miles to Boston. After climbing a total of 90,000 feet, riding eight centuries, fighting headwinds, enjoying tailwinds, fleeing from dogs and snakes, drinking so much Gatorade that I will never drink a lemon-lime sports drink again, and fixing four flat tires, the Atlantic Ocean was a magnificent sight. The cross-country ride was the most difficult challenge I've ever attempted, which made it a very rewarding endeavor. During the journey, I gained more than just strength and fitness. I gained new friends, memories to last a lifetime, a greater appreciation of our country, and a new perspective on life.

Ed. note: Karen is a Faculty Assistant in the Department of Physics. Inspired by her personal hero, Lance Armstrong, Karen turned this into her personal campaign to raise support for The Lance Armstrong Foundation. For more information, please visit ***http://www.livestrong.org***.

Women in Physics

by Morgan Page and Lisa Manning

"Congratulations!" wrote Graduate Advisor Shilo Tucker in an e-mail sent to the Women in Physics listserv this past April. What was the cause for celebration? The incoming class of UCSB physics graduate students includes seven women, far more than in past two years, which had seen only one or two female incoming graduate students per year.

Women in Physics is a group of graduate students, faculty members, post-docs and undergraduates in the UCSB physics department. The group aims to create a sense of community among women in the department, as well as encourage new scientists and students to come to UCSB and join the community.

The group currently meets about once a quarter for lunch. In the past, they have invited professors, women in industry, and science journalists to talk about their research, how they balance their family with their career, and other issues relevant to women in science.

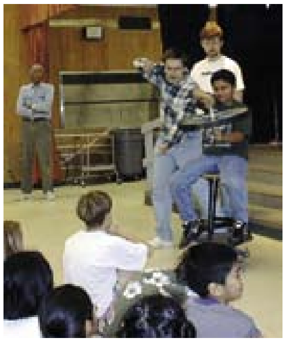
This past year, the Women in Physics group decided to make a concerted effort to reach out to female prospective students. Current grad students in the group emailed three or four prospective students each so that they would already know someone when they arrived. In addition, female faculty volunteered to call incoming students and tell them about research opportunities here. During the visiting weekend, the Physics Department sponsored a Women in Physics coffee hour where prospective students could meet downtown and talk to current grad students about their questions and concerns. It seems that these efforts were successful, as evidenced by the large number of women in the incoming class.

Women in Physics is also planning several new activities and projects in the upcoming year. A welcome lunch for new graduate students took place in September 2005. In addition, members have been working to update the Women in Physics webpage and place this link prominently on the physics website. They are also searching for funds to create brochures highlighting the work of female faculty and describing the positive environment for women in the department. Another potential project involves inviting prominent female physicists to speak to the Women in Physics group and at department seminars.

Thanks to continued support from the UCSB Physics Department, Women in Physics appears to be a growing enterprise.

Anyone who is interested in joining the Women in Physics mailing list or helping out with any of the group's projects can contact the group coordinators Lisa Manning (mmanning@physics.ucsb.edu) and Morgan Page (pagem@physics.ucsb.edu).

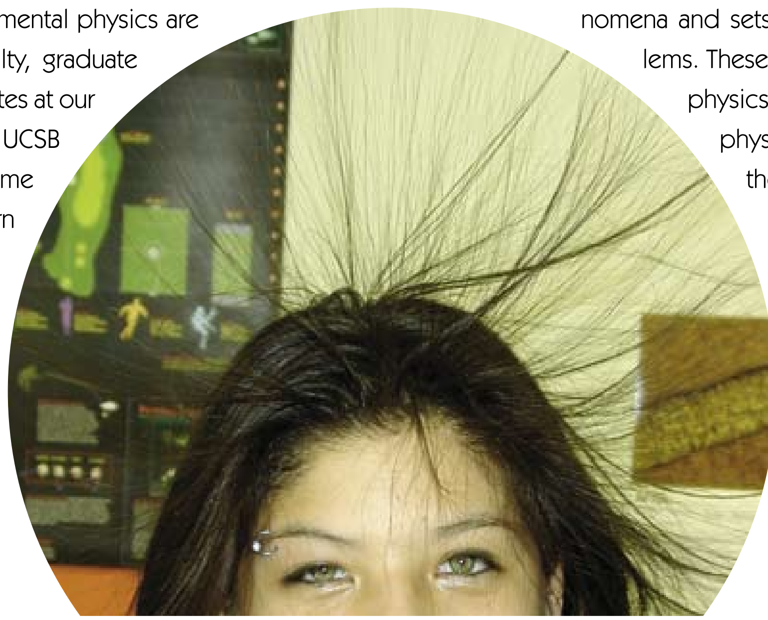
Visit us on the web! http://www.physics.ucsb.edu/~Women/



Rotating wheels, and turning kids on to science!

What happens when you turn a spinning wheel upside down? And why is it so much harder to turn the wheel when it's spinning than when it is not? And what does this have to do with your bicycle? Answers to these and many other questions related to fundamental physics are answered by Physics faculty, graduate students, and undergraduates at our local schools as part of the UCSB Physics Circus. At the same time, UCSB participants learn something new each time from the wonderful questions that are asked!

The **Physics Circus** is a program to promote science education in local K-12 schools. A group of enthusiastic UCSB Physics Department Graduate Students, Undergraduate Students, and Faculty take a collection of demonstration experiments on the road to nearby schools and present an action-packed learning experience linked to children's everyday lives. Follow up tours at the Community Science Center (http://www.physics.ucsb.edu/~csc) at UCSB are available. This year's program is coordinated by Professor Jean Carlson http://www.physics.ucsb.edu/~complex and graduate student Eric Daub.



Faculty and students share in the fun at local schools.

The Physics Circus, conceived eight years ago by Abigail Reid, then a graduate student in physics and education at UCSB, is named after Walker's book (Wiley, 1977), The Flying Circus of Physics. In this book the author takes everyday phenomena and sets them up as physics problems. These problems show the fun that physics knowledge brings to every physicist who tries to understand the world around them.

*To learn more about the **Physics Circus**, visit our website at http://www.physics.ucsb.edu/~circus/. We've had our share of hair raising experiences, and at the end of every show each student gets a hands on encounter with a 77K frozen marshmallow. No one is ever in a hurry to get to recess.*

Broida Makeover

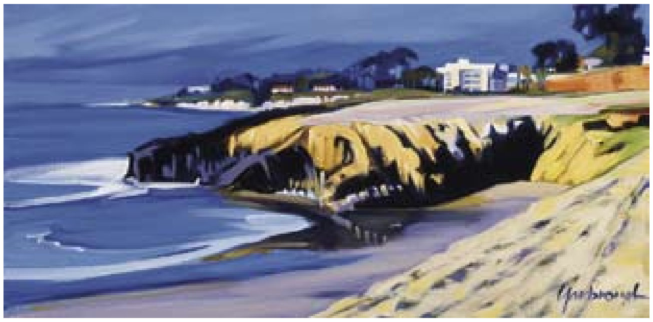
by Prof. Jeff Richman

Help! I don't know how to do this #?!$$@&& physics assignment! What should I do?"

There is good news for UCSB undergraduates in their struggle: the new Physics Study Room (PSR) on the 1st floor is now open, with brand new furniture, computers, and lots of space for students to interact with each other and with Graduate Teaching Assistants. The carpeted room has comfortable chairs, two large conference tables, and computers with computational software and internet access. "We wanted to send the students a strong message that undergraduate physics education is an integral part of the Physics Department," says Professor Jeffrey Richman, an experimental high-energy physicist who initiated the project and obtained funding. Nancy Fraser (department MSO), Mike Deal (Broida building manager), and Glenn Schiferl (Director of Physics Computing Services) all worked to make the project a reality.

While the PSR serves all students taking physics classes, Physics majors now have a room of their own in which to relax and study. They named it "The End of the Universe," after the well-loved watering hole in Douglas Adams' book, A Hitchhiker's Guide to the Galaxy. The 3rd floor room has computers funded by Professor Crystal Martin, an observational astrophysicist. The Physics Department has many more needs related to improving undergraduate education. If you would like to contribute, please contact Professor Mark Srednicki, Department Chair.

Free Print for New Life Members



Kate Yarbrough
Campus from Goleta Beach, 2005

Get Connected!

If you are a UCSB Physics alum, you are invited to link to your web page from our department web site.
For guidelines and information, please visit us online:
www.physics.ucsb.edu/~alumni/alumniopages.html

Graduates of UCSB Physics Department programs qualify for free e-mail forwarding accounts. You will be given an @alumni.physics.ucsb.edu address. E-mail sent to you at that address will automatically be forwarded to your preferred e-mail address. Should that address change, you update our record of your preferred address, but the change is invisible to your correspondents: they continue to use the same @alumni address.

UCSB is very well connected to Internet2, and we expect no appreciable delays in forwarding your e-mail.

This forwarding service is not an Internet service provider. You must have an independent e-mail account to store your e-mail.

We respect the privacy and time of our alumni. We will not disclose your e-mail address to any outside vendor, nor will we pester you with daily news messages.

For more information, or to sign up for this service, please send an e-mail to alumni@physics.ucsb.edu

From the UCSB Physics Wish List:

- ☆ Increase support for graduate fellowships, which will enhance our ability to attract the highest quality students.
- ☆ Combine and improve the graduate student lounge and computer room to bring them up to the standard of our remodeled undergraduate facilities.

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