UCLA

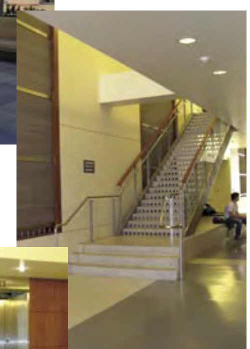
Department of Physics & Astronomy

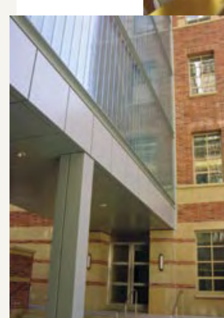
Annual Report 2004-05

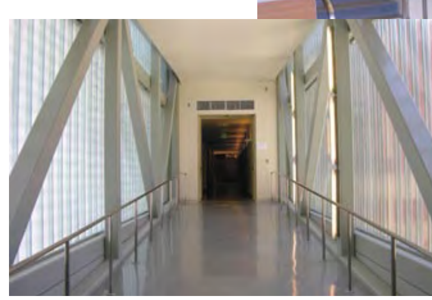
Reinvent yourself in physics & astronomy

New Physics & Astronomy Building (PAB)

The new Physics and Astronomy building (PAB) became a reality with its inauguration on November 13, 2004. Featured here are a few pictures to show the progress of the construction and the end result. The picture top left is of the construction inauguration that took place on October 1, 2001. (From left then department chair Claudio Pellegrini, then Provost Brian Copenhaver, vice chancellor of research Roberto Peccei, and dean Tony Chan). Above center is an aerial view of the construction site in 2002 adjacent. Pictures on the right show the inside and outside of this beautiful state-of-the-art building. The photograph on the bottom left is of the PAB finally completed. Pictures on the left are of the inauguration celebration.







Department of Physics & Astronomy 2004-2005

University of California, Los Angeles

*Joseph Rudnick,chair
2004-2005*

Message from the Chair

The past year has been an exciting one. The Astronomy and Physics divisions in the Department of Physics and Astronomy now share a common home, the cluster consisting of the Knudsen Hall and the newly completed Knudsen Hall Annex. The latter building is now known generically as the Physics and Astronomy Building (PAB for short). The Department has formally vacated Kinsey Hall, its first home and one of the original buildings in the UCLA's Westwood campus. In fact, the official name of Kinsey Hall is presently "Humanities Building, (formerly Kinsey Hall)," a sobriquet that it will carry through the period of extensive renovations now being implemented and until a new name has been found. However, we have not forgotten about E. Lee Kinsey, an early Chair of the Department of Physics and an important figure in its history. The classroom cluster in Knudsen Hall is slated for a naming ceremony, in which it will be endowed with the title Kinsey Teaching Pavilion.

The dedication of PAB took place last November at a festive ceremony attended by faculty, students, alumni and friends of the department. On the same day as the dedication, Professor Geoffrey Marcy, the second recipient of the Physics and Astronomy Alumni Alliance's Outstanding Alumni Award delivered a lecture on his work discovering planets outside our solar system. It was a personal pleasure participating in all aspects of the building dedication and festivities honoring Professor Marcy. I was especially delighted to be able to meet the many alumni who made time to visit us then. I should say that I am always happy to talk to our alumni and friends. If you have not visited us lately, please take this as an open invitation to drop by.

The faculty, students and researchers here continue to make significant contributions to progress in our fundamental understanding of nature. I refer you to the notes inside this annual report. Furthermore, the Department continues in its commitment to provide the best possible education to our students. Our new Biophysics major has proven to be a real success. As of now, 21 students have signed up for this demanding course of studies, designed to prepare them to work at the interface between physics and biology. We have also undertaken a comprehensive review of the undergraduate curriculum, in order to keep up with evolving developments in physics and astronomy and to enhance the effectiveness of our educational program.

I would like to extend the profound gratitude of the department to our supportive alumni, whose donations have contributed substantially to our ability to carry out our mission and to the quality of life in our department. In the body of the report, you will see mention of the beautifully renovated Leonard Lounge, made possible by their generosity. In addition, there are alumni and friends who have made contributions that we are able to acknowledge by attaching their names to rooms and facilities in PAB. I am honored to mention in particular Michael and Gretchen Kriss, Howard and Astrid Preston, Ben and Carol Holmes and Anthony J. Arsini.

High energy physics at UCLA has played a central role in the growth of our department to a front-line research and educational enterprise. Beginning with the three faculty members who brought Ernest O. Lawrence's cyclotron down from Berkeley and continuing to our present participation in experimental work at the most advanced national and international facilities, UCLA's presence in the field of high energy physics has been important to our institutional growth and to fundamental advances in the field. The feature article in this year's annual report recounts in necessarily brief outline the history of high energy physics in our department. As members of the UCLA Department of Physics and Astronomy carry on in their world-leading activities this history will continue to unfold, so what you see in this report should be read as a snapshot of an evolving saga.

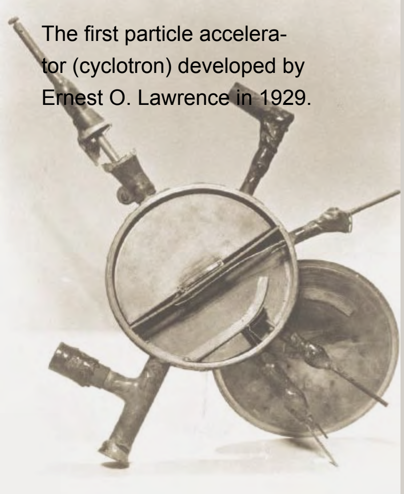
Finally, it is my pleasure to introduce to you two new members of our faculty: Professors Dolores Bozovic and Chris Regan. Profiles of these outstanding young scientist are on pages 24 of this report.

*Ferdinand Coroniti, vice-chair
2004-2005*

Contents

Atom-Smashers

From the beginning of the atomic age to the present, three generations of scientists have made pioneering contributions to the UCLA high-energy physics program. Their work has helped to define the modern world, and their legacy has set a standard for the future.



The first particle accelerator (cyclotron) developed by Ernest O. Lawrence in 1929.

1946 – 1972 Early Nuclear Physics

Before there was high energy physics, there was nuclear physics: the splitting of the atom and the development of the atom bomb. From the early 1930s, a nuclear physics program was energetically pursued at UC Berkeley under the direction of the brilliant scientific pioneer **Ernest O. Lawrence,** and in early 1946 a decision was made to establish a nuclear physics program at UCLA. **J. Reginald Richardson,** Lawrence's graduate student and one of the scientists whose work was so essential to the success of the Manhattan Project, was recruited to lead the new program. He arrived with colleagues **Kenneth R. MacKenzie, David S. Saxon,** and **Byron T. Wright** (also Lawrence's student)—and a recently upgraded 37-inch-cyclotron.

Cyclotrons

UCLA's first cyclotron played an important role in the history of early fission. It was the first in the world and during its tenure at UC Berkeley, it enabled Lawrence to split the atom, earning him a Nobel Prize in 1939. The cyclotron went through several upgrades in its lifetime and by the time it was retired in1962, it was hardly recognizable from its humble beginnings as a long-range radio communications device.

Initial results from work conducted on this machine at UCLA were published in 1950. Through the next decade, the cyclotron (and others like it) provided much information about what happens when particles at low and extremely high energies collide with an atomic nucleus. At UCLA, over 20 doctorates were awarded for experimental research utilizing the cyclotron.

December 8, 1960. The new UCLA cyclotron is shown with two of its physicist designers, Byron T. Wright (left) and J.R. Richardson.

By the mid-1950s a new, more powerful machine was being planned—a 49-inch, 50-million-electron volt (MeV) wonder that would maintain UCLA's competitive position in the field of experimental nuclear physics. Richardson, MacKenzie and Wright led a team of newly recruited staff to build and design this first "spiral ridge cyclotron," completing it in 1962 at a cost of $75,000. Not only was it a major research tool, but it trained a number of the nation's nuclear physicists. It became obsolete by 1970 with the development of more powerful accelerators elsewhere in the United States, and in Europe and Russia.

Richardson would come to be considered the "dean of the world-wide cyclotron community." One of his major accomplishments was the realization of the TRIUMF Meson Factory in Canada, where he led the construction of that cyclotron and became the laboratory's second director. MacKenzie and Wright were also well recognized cycotroneers. MacKenzie went on to initiate the program in experimental plasma physics at UCLA. Richardson died in 1997 and Mackenzie in 2002. Wright, who is currently professor emeritus, contributed to the methods used to produce external beams from several particle accelerators. He also developed the undergraduate nuclear physics laboratory at UCLA.

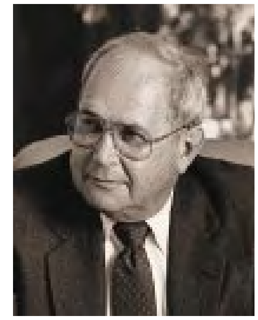
Saxon's role in UCLA's nuclear physics program was as a theorist. His many scientific contributions include the Saxon-Woods potential. This involves the proper interpretation of some unexpected results obtained in the UCLA cyclotron laboratory. However, he is probably better known to the academic world for his accomplishments as an able leader and administrator. Following appointments as department chair, dean, executive vice chancellor and finally UC president, he assumed prestigious positions outside the UC university system before returning to UCLA as professor emeritus.

Bubble Chambers

The invention of the bubble chamber in 1952 created an exciting new tool for scientific investigation that lasted decades. Beginning with limited experiments at individual universities, bubble chambers were eventually incorporated into the large, international accelerators. For UCLA physicists **Howard K. Ticho, Donald H. Stork, William E. Slater,** and **Peter E. Schlein,** the 1960s proved to be a highly productive period. Ticho and Stork were instrumental in designing separated beams of strange particles at the Lawrence Berkeley National Laboratory's Bevatron accelerator in collaboration with Luis Alvarez and colleagues. These beams led to the discovery of many new strange particle states, ultimately leading to a Nobel Prize for Alvarez in 1968 and the discovery of the ϕ and Ξ^* particles by the UCLA group under Ticho's leadership. Their work provided the first convincing evidence for the existence of the so-called baryon decuplet, which was a systematization of elementary particles that led to the notion of quarks as the fundamental constituent of the hadrons or heavy particles, including the proton, the neutron and all the mesons.

After leading the program in high energy physics at UCLA Ticho became the dean of the physical sciences division and then moved to UC San Diego 35 years later as vice chancellor for academic affairs. He is currently professor emeritus there. Stork, who was regarded by students and colleagues throughout his long career at UCLA as an exceptional mentor was particularly known for his work on K+ mesons. Stork died in 2000. Slater continues his life-long career at UCLA. He is well-known for designing and building measuring devices that have been crucial to successful experiments with the bubble chamber. Schlein performed one of the first detailed analyses of pion-pion scattering.

Two other high energy experimentalists joined UCLA in the late 60's: **Darrel Drickey** in 1967 and **Charles Buchanan** in 1968. The untimely death of Professor Drickey in 1974 was a grievous loss to UCLA and the scientific community. Buchanan has had an extended and fruitful association with this department. His long-time interest in research focuses on the physics of hadronization, the process by which scattered quarks recombine into hadrons.



Howard K. Ticho

Donald H. Stork

Peter E. Schlein

William E. Slater

1972 – Present High-Energy Physics

By the 1970s, the evolution of nuclear physics created several new specialties. High-energy physics assumed the preeminent role, spurred by the development of large accelerators that grew into national and international centers of research. UCLA scientists gravitated to the accelerators at Fermilab, SLAC and CERN to conduct their experiments.

Located outside Chicago, Illinois, Fermilab was commissioned by the U.S. Atomic Energy Commission in 1967 as the National Accelerator Laboratory. Renamed in 1974 in honor of Enrico Fermi, it is currently the largest accelerator in the United States and second in the world only to CERN, the European Laboratory for Particle Physics. Founded in 1954 in Switzerland, CERN was one of Europe's first joint ventures. It now serves 20 countries and with the imminent inauguration of the Large Hadron Collider (LHC), it is poised to become the world's premier resource for the study of particle physics.

At the same time, UCLA high energy physicists Ticho, Slater, Stork and Buchanan pursued an active program at the Stanford Linear Accelerator (SLAC), concentrating their energies on two detection devices: (1) the DELCO (direct electron counter) of which the key component, a large ethane gas Cerenkov counter, was built by the UCLA group, and (2) a more general facility known as the Time Projection Chamber (TPC), to which the UCLA contributed key components, including the Pole Tip Calorimeters (PTC). In its active phase, this TPC was the first of its genre and was arguably the most powerful particle detector in the world. The DELCO detector confirmed the discovery of the third generation tau lepton and measured many of its properties.

Intersecting Storage Rings (ISR) and the CERN proton-antiproton collider

The first colliding beam facility, the intersecting storage rings (ISR) was developed at CERN in the early 1970s, creating the opportunity for elementary-particle physicists around the world to conduct experiments in proton-proton collisions at the highest energies then available, far above those traditionally studied in nuclear physics experiments. Working there and subsequently at the CERN proton-antiproton collider, Schlein became an acknowledged leader in high energy collider physics, creating an influential center of scientific activity at UCLA. Schlein's UA8 experiment in 1985-89 at the CERN collider resulted in the discovery of the partonic structure of the Pomeron. The technology first used in UA8 is now part of every hadron collider experiment. He and his colleagues were responsible for several experiments that have contributed substantially to the development of the physics program at the new LHC. Experiments performed by Schlein and collaborators led the way to the forward B-physics experiment (LHCB), first proposed by Schlein's group in 1993, which was made possible by the group's invention and proof-of-principal demonstration of a novel microvertex detector technology at the CERN proton-antiproton collider in 1990.

On the strength of UCLA's success, a number of new faculty members were recruited to the department's high energy physics group in the 1980s and '90s: **Robert D. Cousins, Thomas Mueller, David B. Cline, Jay Hauser, Katsushi Arisaka,** and **David Saltzberg**. Mueller returned to Germany in the mid-1990s. **Rainer S. Wallny** joined the UCLA team in 2002.

Collider Detector at Fermilab (CDF)

For 18 years, from the late 1970s to the mid-1990s, the major effort at Fermilab was the search for the top quark. Scientists utilized two experiments: the D∅ and CDF. Hauser, Saltzberg and Mueller, working on CDF, were three of the 800 scientists credited with the discovery of the top quark in 1995-1996. Since then, physicists have been investigating the properties of the top quark particle.

Hauser, Saltzberg and colleagues have focused much of their efforts from the late 1990s to the present on a major upgrade at Fermilab, called CDF-II, including the installation of a new solid scintillator-based detector. CDF-II has been used by several generations of UCLA doctoral students to increase the number of top quarks collected and analyzed. The detector will continue to define the high energy frontier for the next few years. Hauser, Saltzberg, Wallny and colleagues (the UCLA CDF group) are looking for signs of supersymmetry, a new theory of physics that doubles the number of particles in nature. Supersymmetry would solve the deep mathematical problems prevalent in current theories and provide a particle that could solve the long-standing "dark matter problem" in the Universe.

Conservation laws play a fundamental role in physics. At the subatomic level, the violation of conservation laws reveals important information regarding the structure of matter and the rules that govern its behavior. Three UCLA physicists have searched for and scrutinized violations of conservation laws in processes involving the K meson, also known as the Kaon. Robert Cousins was the leader of a collaboration looking for violation of conservation of separate lepton number in the form of the decay of a Kaon to a muon and an electron. Katsushi Arisaka, whose first association with UCLA was as a post-doctoral researcher on this experiment, went on to investigate properties of CP violation in rare Kaon decays in a collaboration led by Professor Bruce Winstein of the University of Chicago. Winstein, an alumnus of UCLA (BA in Physics and Mathematics, 1965), is also the first recipient of our Outstanding Alumnus Award and was the keynote speaker at this year's departmental commencement ceremonies.

From 1994-2000 Cousins was a member of the NOMAD collaboration at CERN, which studied in detail over a million recorded interactions of the elusive neutrino particle, and which searched for tranformations among types of neutrinos. During a sabbatical year at CERN, he was co-leader of the physics analysis of this largely European collaboration.

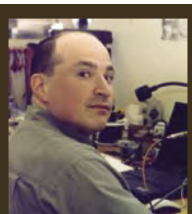

Charles Buchanan


Robert D. Cousins


David B. Cline


Jay Hauser


Katsushi Arisaka


David Saltzberg

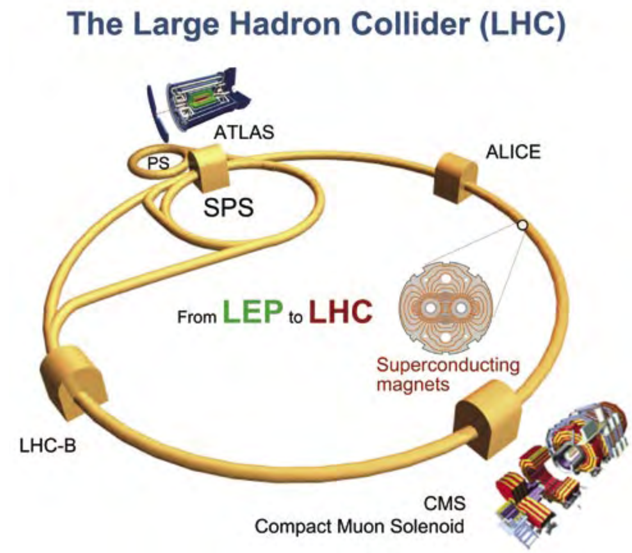

Rainer Wallny

Large Hadron Collider (LHC) and Compact Muon solenoid (CMS) at CERN

During the early 1990s, the frontier of particle physics was clearly destined to move toward a new laboratory called the Superconducting Super-Collider (SSC), which was being built in Texas. However, that project was cancelled by Congress in late 1993 as part of a budget-cutting process. Thereafter, UCLA physicists Schlein, Cline, Arisaka, Hauser and Cousins turned their attention to CERN and the LHC. The LHC at CERN promises to exponentially expand our understanding of the Universe, solving riddles that bedevil current researchers and taking the physical sciences beyond the Standard Model that presently serves as its theoretical base. The LHC will accomplish this feat by accelerating protons to an energy that is seven times higher than the capability of Fermilab.

When the LHC begins taking data, projected for late 2007, the first major goal will be the discovery of the long-sought Higgs boson that is a centerpiece of the theory of electromagnetic and weak forces, and gives masses to elementary particles. It is believed that the Higgs boson, if it exists, should be detectable at the LHC; and if it does not exist, there will be new discoveries. The LHC also has the potential for unlocking the theory of supersymmetry and “Z-prime” particles.

UCLA physicists are now heavily involved in the large LHC experiment known as the Compact Muon Solenoid (CMS), which is now being built.



David Cline was a signator of two original Letter of Intent for the CMS project

In particular, they have concentrated their efforts on the construction of a large subdetector that detects muon particles. Muons are highly penetrating particles that are outstanding signatures of Higgs bosons. Arisaka and Cline assembled the muon detectors and are currently commissioning them at CERN, while Hauser is producing electronics for collecting the muon detector data. Cousins has developed software to simulate the muon system for analysis. Schlein and colleagues joined the CMS experiment in 1996 and have contributed to its high speed data acquisition system. He is also involved in planning for measurements of Higgs production and other aspects of the hard diffractive process discovered in his UA8 experiment.

In 2004 Cousins was appointed deputy manager of the U.S. CMS program at CERN. This is the program’s highest-ranking position in line management to be held by a university-based physicist.

High Energy Astroparticle Physics at UCLA

One of the emerging frontiers of physics involves the detection and analysis of the signals from outer space known as cosmic rays. Three members of the UCLA’s high energy physics community are in leadership positions in groups seeking to learn more about the fundamental makeup of matter, as well as about the structure and history of the cosmos from the particles that reach the earth from the outer reaches of our universe. David Saltzberg and collaborators are looking for cosmic neutrinos, using the Antarctic ice sheet as a detector in the ANITA long-duration balloon experiment. Katsushi Arisaka is involved with several collaborations exploring high energy cosmic rays, including, HiRes at Utah and Pierre Auger in Argentina. David Cline leads the UCLA dark matter detection group, a key element in the England-based ZEPLIN dark matter search collaboration, in which a liquid Xenon-based detector is being utilized to find evidence for the existence of Weakly Interacting Massive Particles (WIMPs) as a constituent of the dark matter that is known to provide the dominant contribution to the mass of the universe

Clearly, the future of high-energy physics lies with the scientific work that will be done by current and future generations of scientists. The UCLA physics program aims to maintain its leadership position in this effort, carrying on the legacy that began almost 60 years ago.

We are saddened by the passing of David S. Saxon on December 5, 2005

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The Ben Holmes Auditorium 1-434A.

Leonard Student Lounge

A generous donation from alum Michael Kriss (UCLA PhD, 1969) has made it possible to purchase new furniture for the Leonard student lounge. The furniture will create a comfortable and attractive space for working and lounging. The floor and kitchen were installed last year from alumni donations that raised over $15,000.

Undergraduate physics student Alexandra Lampert received a scholarship that honors the memory of Dr. Waldo Lyon, a long-time employee of the U.S. Navy who is generally regarded as the "father of the submarine arctic warfare program."

From left: Alan Hayashida, Alexandra Lampert, U.S. Navy VADM John Nicholson, and Lory Walls (Dr. Lyon's daughter)

The Preston Family Reading Room

The Anthony J. Armini Classroom

Dr. Anthony J. Armini, MS 1964, PhD 1967, Physics, is Chair, President, and CEO of Implant Sciences Co. Last year, he made a gift of 11,000 shares of Implant Sciences stock to help underwrite construction costs of the Physics and Astronomy Building. In appreciation of this generous gift, room 1-479 in the Physics and Astronomy Building has been designated The Anthony J. Armini Classroom.

Dr. Armini received his PhD under the guidance of Professor J. Reginald Richardson, with whom he published several papers on the mass and decay of various ions. Dr. Armini and his UCLA colleagues performed their research in the UCLA Cyclotron, which was removed to provide adequate land for the Physics and Astronomy Building.

The Anthony J. Armini Classroom provides undergraduate and graduate students in Physics and Astronomy with updated and much-needed instructional facilities. The Department of Physics and Astronomy is grateful to Dr. Armini for his kind support and commitment to the department and its students.

PAAL OUTSTANDING GRADUATES:

Lee Loveridge

Jennifer Carson

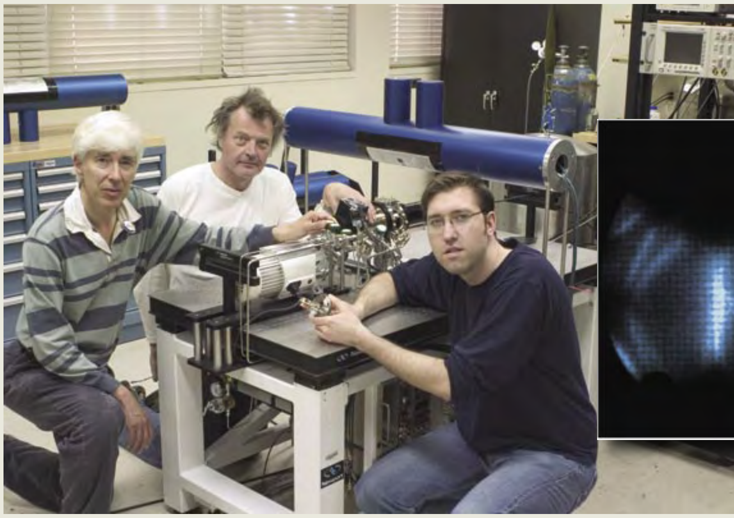
CAREER DAY 2005

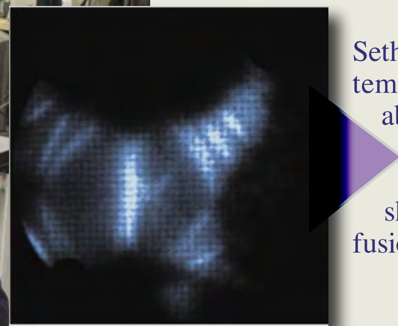
The PAAL-sponsored career day, held at the new PAB's 4th floor conference room, brought together alums and friends of the university to speak with students about their careers. Career day is attended by undergraduate and graduate physics and astronomy students, as well as students from other departments, such as chemistry and engineering. This year there were panelists from JPL, L-3 Communications, Electron Technologies, Inc., Northrop Gruman, Raytheon Electronic Systems, UCLA Career Center, and Universal Motion Pictures. The turn-out was good and the students were anxious to ask questions of the panelists.

PAAL ALUMNI AWARD DINNER & LECTURE 2004

The PAAL Alumni award has been created to recognize important contributions by UCLA alumni to physics and astronomy, as well as to the welfare and economic development of our country. This year the award was given to Geoffrey W. Marcy (UCLA BA, 1976). The dinner and lecture were held in conjunction with the inauguration of the PAB on November 13, 2004. Marcy is the director of the Center for Integrative Planetary Science and a professor of astronomy at UC, Berkeley. He also directs the pioneering team at the Lick and Keck Observatories that has found the majority of known planets outside of our solar system. He received his doctorate in astronomy and astrophysics from the UC, Santa Cruz in 1982. Before joining the UC Berkeley faculty in 1999 Marcy was a professor of physics and astronomy at San Francisco State University. Prior to that, he was a fellow at the Carnegie Institution of Washington. Professor Marcy is a member of the National Academy of Sciences and has garnered many prestigious awards, such as the Shaw Prize, an international award that honors individuals who have achieve excellence in their chosen field .

Cold Fusion, for Real





Seth Putterman's group in a system-pyroelectric crystals were able to achieve nuclear fusion in a very simple compact arrangement. An image showing the relative rates of fusion in the cell is shown here.

From left: Seth Putterman, Jim Gimzewski, and Brian Naranjo

A Physicist's Dream

UCLA professor and renowned physicist John Dawson would be proud of his namesake. It's a 256 dual-node computing cluster that can process vast amounts of data faster and cheaper than anything Dawson ever used. Shown here on March 23, 2005, Warren Mori is putting the last node in place. Professor Mori is the principal investigator on the National Science Foundation grant that paid for the Dawson Cluster. See website: http://www.ats.ucla.edu/news/spotlight.htm#physicistsdream

John Dawson

At the Bottom of the World

David Saltzberg's neutrino astronomy group has been working on the ANITA experiment in the Antartic. ANITA will be the most sensitive experiment to date in the EeV energy range, and hopefully will observe the so-called "GZK" neutrinos. The first test flight was this year from the NASA balloon base in Fort Sumner, New Mexico.

Eric Becklin *Forty Years of Infrared Astronomy*

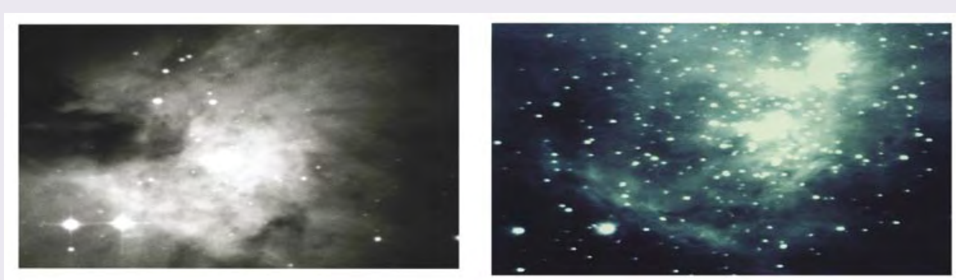
Forty years of infrared astronomy: a tribute to Eric Becklin April 1-2, 2005, Double Tree Hotel, Westwood, California.

This highly successful event was organized by Ian McLean to celebrate the 65th birthday of Eric E. Becklin in April 2005. Eric is one of the founders of the now booming field of infrared astronomy. His career spans 40 years, from his days as a graduate student at Caltech with Gerry Neugebauer, through his leadership of the NASA Infrared Telescope Facility on Mauna Kea, Hawaii, to his current position as professor of astronomy at UCLA and science director of the Stratospheric Observatory for Infrared Astronomy. His early work on the discovery of infrared sources in Orion includes the famous Becklin-Neugebauer (BN) object. His later work includes the discovery of infrared emission from the center of our galaxy, and work on brown dwarfs, star forming regions, and distant dusty galaxies. Eric has been a pioneer and leader in his field. The two-day meeting brought together over 150 of his former and current students and colleagues, as well as many who have been influenced by his career. About 30 members of Eric's family also attended. At the dinner ceremony, McLean led a tribute to Becklin and presented him with a custom-engraved glass ornament on behalf of his colleagues at UCLA. Former colleagues from Caltech presented him with the original chart recorder used in the detection of the galactic center. The pictures opposite were included in the printed program.

Stratospheric Observatory for Infrared Astronomy project (SOFIA) Eric Becklin is the leader of all SOFIA science activities. He works to see that the observatory science goals are met and to ensure that the design, implementation, and operation of the observatory – including its telescope and instruments – will meet these goals. He closely reviews the expected performance and integration plans for the 2.5m telescope, and the ongoing development of the suite of facility instruments being readied for the astronomical community for first-light science. Becklin's personal research interests include the investigation of the nature of young stellar objects, planetary systems, the Galactic Center and other galactic nuclei.

25th Anniversary of IRTF and UKIRT

October 2004 was the 25th Anniversary of the NASA Infrared Telescope Facility (IRTF) and United Kingdom Infrared Telescope (UKIRT). The occasion was celebrated with a banquet at the University of Hawaii at Hilo, a special historical discussion panel, and public summit observatory tours.



On the left is an optical photograph of the famous Orion Nebula. The over-exposed bright area near the center is due to the stars of the Trapezium cluster. Very few other stars can be seen, and the region above the Trapezium appears empty. However, in a painstaking survey almost 40 years ago, Eric Becklin and Gerry Neugebauer discovered a very bright infrared object embedded in the cloud; it is now known as the BN object. On the right is a modern picture of (almost) the same region taken with an infrared camera. The BN object is in the bright region to the upper right above the Trapezium stars. Many more stars embedded in the nebula are revealed by the infrared image.

Galactic Astronomy

Eric Becklin's major research over the last year has been the search for High Mass Planets and Brown Dwarfs in various astronomical environments using the Keck 10 meter telescope and the Gemini 8 meter telescope. Graduate students **Michael Schwartz** (astro) and **Jay Farihi** (physics) have finished their theses under Becklin during the last year. In a related study, Becklin worked with **Alycia Weinberger** and **Ben Zuckerman** to detect organic material in a nearby debris disk.
Becklin, with **Inseok Song,** Alycia Weinberger, and **Ben Zuckerman**, discovered a debris disk around a solar like star with processed crystal silicates in the earth region. Becklin continues his work on the nature of the center of our galaxy along with **Andrea Ghez** and **Mark Morris.** This includes the measurement of stellar orbits of stars traveling near the Black Hole and measurement of variable infrared emission from the region directly surrounding the Black Hole. A majority of Becklin's time has been spent on the planning for operations of SOFIA, which will begn in early 2007. He continues as chief scientist and directory designate of SOFIA.

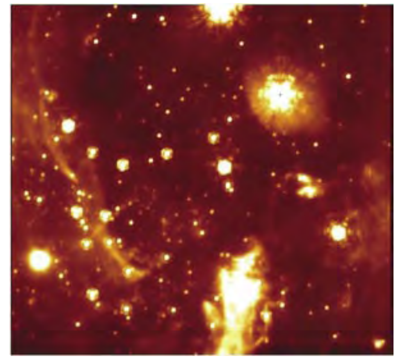
Andrea Ghez and colleagues have obtained the first Laser Guide Star Adaptive Optics (LGS-AO) observations of the Galactic Center. This has dramatically improved the quality and robustness with which high angular resolution infrared images of the Galactic Center can be obtained with the W. M. Keck II 10-meter telescope. During our these observations, the infrared source associated with the central supermassive black hole showed significant intensity variations. Near its peak intensity, they made one of the first measurements of its color. This has allowed them to learn about the physical conditions of the plasma accreting onto the central supermassive black hole. Ghez and group have also discovered what may be the remains of an infalling cluster of young stars at the center of our Galaxy. The possibility of infalling clusters has been much debated, so this data set presents the exciting possibility that they do exist and provides a way of quickly shuttling in young stars from a region more conducive to star formation to a region that is quite hostile to star formation, but that fully formed stars can withstand.

Ian McLean continues as co-chair of the Keck Science steering committee and associate director of the University of California Observatories.

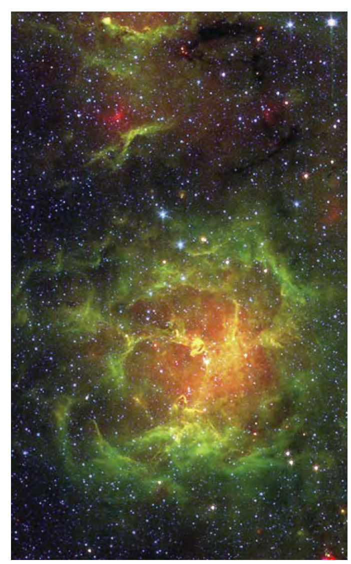
Brad Hansen, in collaboration with colleagues at UCLA, UC Santa Cruz and the University of British Columbia, continues his work on white dwarfs in stellar clusters. Keck telescope spectra of white dwarfs in the open cluster NGC 2099 yielded mass determinations which placed new constraints on the relationship between the initial masses of stars and their final masses at the end of nuclear burning. Hansen and colleagues began an effort to model the white dwarf population in NGC 6397, a nearby globular cluster. This population was recently detected in a long Hubble Telescope campaign. This project follows the successful program on the globular cluster M4, and promises to place new constraints on the age of our galaxy.

Michael Jura has been studying the environments around other nearby stars to understand better the formation and evolution of asteroids, comets and planets. The long-term goal is to learn whether there is extraterrestrial life. Their most important tool has been the Spitzer Space telescope which was launched in August, 2003. (Jura is an interdisciplinary scientist on this project.) An interesting result is that he has identified a method to discover evolved oceans on extrasolar planets.

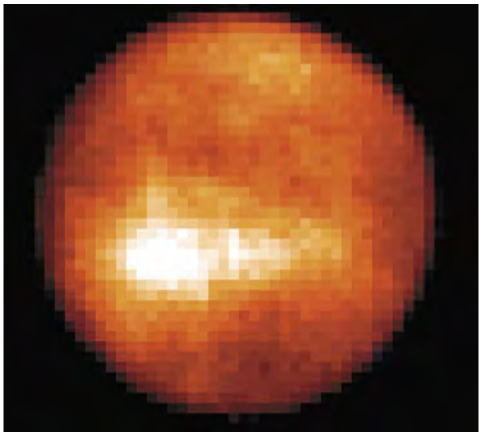
Ian McLean is the director of operations of the UCLA Infrared Laboratory with a staff of nine people. Among the projects undertaken by the lab was OSIRIS, an instrument for the Keck Observatory, which was completed under the leadership of **James Larkin**. Another instrument, FLITECAM, the first-light IR camera for SOFIA, received two new operational modes and is now in the final stages of integration and testing before delivery. An 8-month conceptual design study was carried out for MOSFIRE, the first multi-object infrared spectrometer for the Keck Observatory. MOSFIRE, which has now become a funded project for the Lab with McLean as PI, will have up to 45 cryogenic slits that are reconfigurable under computer control over a field of view of 6 x 3 minutes of arc



The Laser Guide Star Adaptive Optics System at the W. M. Keck Observatory takes infrared images of the Galactic Center. The image above, taken in the L'-band (3.8 microns), is 10 arcseconds in size and has a resolution of 82 milliarcseconds. At 3.8 microns, the Strehl ratio was measured at 75%, double the previous performance at this wavelength.



NASA's Spitzer Space Telescope has uncovered a hatchery for massive stars.



This image shows an infrared image of Saturn's moon Titan. The image was produced from roughly 3000 spectra taken simultaneously with the OSIRIS spectrograph. Each pixel of the image is actually the sum of roughly 50 different wavelength channels where light can penetrate to the moon's surface. At other wavelengths, the stratosphere and troposphere can be studied. Each pixel in the image corresponds to roughly 130 km. The surface features are linked to continent-like structures covered in water ice.

to enable the spectra of many stars or galaxies to be obtained simultaneously. Professor McLean also contributed to WISE (the Wide-field Infrared Survey Explorer) mission led by **Ned Wright**, and he hosted the annual Keck science meeting at UCLA in October 2004. McLean's primary observational project at the Keck Observatory, the NIRSPEC Brown Dwarf Spectroscopic Survey, achieved another major milestone with the completion of a study of over 50 very young sub-stellar objects. The younger a brown dwarf, the larger its radius and therefore the smaller the acceleration due to gravity , which determines the pressure balance in the atmosphere which in turn affects the appearance of infrared spectral lines. This determines the pressure balance in the atmosphere, which in turn affects the appearance of infrared spectral lines. This research is part of the thesis of **Mark McGovern.**

Mark Morris has continued working on the center of the Galaxy in collaboration with Andrea Ghez as discussed elsewhere by Becklin. In addition, Morris has worked with German astronomers to study infrared flares from the black hole that coincide with X-ray flares. The simultaneous flares can reveal how the black hole accretion disk actually "shines." With post-doc **Michael Muno** and UCLA astronomy alumnus Fred Baganoff, Morris has used the Chandra X-ray observatory to study X-rays from the Galactic center, finding evidence for a central cluster of as many as 10,000 stellar-mass black holes or neutron stars. An extended distribution of diffuse, hot xray emission from the Galactic center has been observed and considered to accompany a powerful Galactic wind blowing out of the center of the Galaxy. Working closer to home, Morris has been using the Hubble Space Telescope and the Keck Telescopes to study stars undergoing the natural brief transition from red giant to white dwarf at the end of their lives. This is a very photogenic stage, as the stars emit clouds, or shells, of gas that flow away, but are illuminated by the core of the mass-losing star.

***Edward L. Wright** is the principal investigator for the WISE (Wide-field Infrared Survey Explorer) mission, which was confirmed by NASA to enter into a Phase B study.*

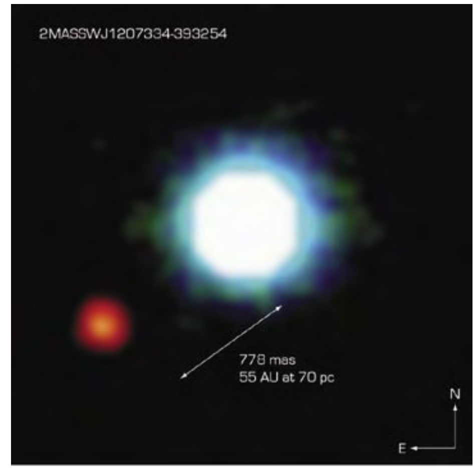
Ben Zuckerman is a member of a joint French/American team that has been using adaptive optics (AO) imaging techniques on ESO's Very Large Telescope in northern Chile to search for infrared emission from young planets. The young target stars have been identified by Zuckerman's research group at UCLA. During the past year, the team reported AO discovery of two young objects of planetary mass (Chauvin et al 2004, 2005a, 2005b); one orbits a star, the other orbits a brown dwarf. These objects are the first planets to be directly imaged outside of our solar system. The planet that orbits the brown dwarf has a mass about four times that of Jupiter. This is the first time a planet has been detected in orbit around a brown dwarf by any observing technique, direct or indirect. Zuckerman along with UCLA colleague Eric Becklin and two others, discovered a uniquely dusty sun-like star, BD+20 307. They are interpreting the BD+20 307 phenomenon as evidence of recent massive and violent collisions of objects perhaps as large as planets.

Extra Galactic Astronomy

In February, 2005, **James Larkin's** research group and engineering staff obtained first light with the OSIRIS spectrograph on the Keck telescope on the summit of Mauna Kea, Hawaii. The two-ton instrument works with an adaptive optics system to correct for the blurring effects of the atmosphere and produce images more than 10 times sharper than traditional methods. But more importantly, the spectrograph takes up to 3000 spectra simultaneously over a rectangular field of view. This in effect allows the team to take hundreds of simultaneous images of a target at different wavelengths. This can include performing surface chemisty on a nearby moon like Titan, or measuring star formation in an extremely distant galaxy less than one billion years after the Big Bang. The team is now toward the end of the commissioning phase of the instrument and has observed a wide range of targets. As a facility instrument, more than a dozen groups are planning to use OSIRIS in the next year.

Matthew Malkan and graduate student **Erin Hicks** used adaptive optics on the Keck Telescope to weigh the supermassive black holes in several Seyfert 1 galaxies. Modeling of the motion of molecular gas in the nuclear region of the active galaxies has provided the first direct black hole mass estimates for these objects. Reliable black hole masses are vital to the understanding of active galactic nuclei as well as the evolution of all galaxies. Results were presented at both the Superunification of AGN and the Nearly Normal Galaxies meetings.

Jean Turner, along with former student, **David Meier**, published the first imaging survey of molecular lines in a galaxy other than our own,in the center of the spiral galaxy, IC 342. Their principal component analysis of the images revealed that the lines fell into three groups: shocked molecules, highly irradiated molecules, and quiescent gas tracers. These groups are not found in the same molecular clouds, but appear to trace conditions in different parts of the galaxy. So it appears that high resolution images of molecular clouds can not only tell us about dynamical conditions within the galaxy, through the specific molecules that are detected, but also show the chemical pathways by which these molecules are formed. For example, the molecule HNCO, whose formation path had been unclear, is probably produced in molecular clouds that have recently undergone shock processing, since it is highly spatially correlated with methanol, which is known to be produced in shocks.



ESO PR Photo 14a/05, the first planet outside of our solar system to be imaged, orbits a brown dwarf (center-right) at a distance that is nearly twice as far as Neptune is from the sun.

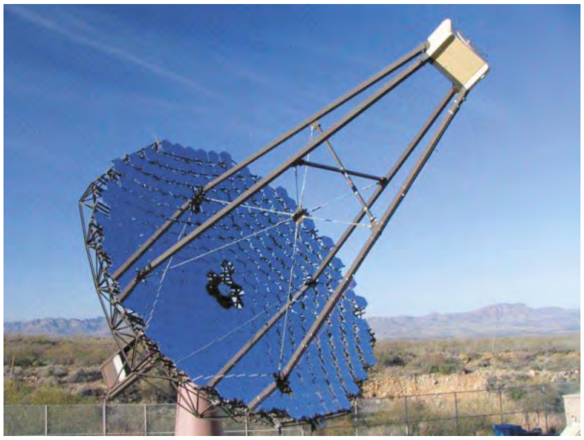
Astroparticle Physics

David Cline and **Hanguo Wang** have made excellent progress this year having moved into the UCLA dark matter laboratory (the only such lab in the south of the USA). Support for the lab came from the DOE and Dean Chan for equipment in the laboratory. Cline and associates were just approved to bring ZEPLIN IV (a one-ton detector) to a new, very deep laboratory (SNOLAB) in Canada (the deepest in the world). Cline's group has analyzed the complete sample of very short duration Gamma Ray Bursts (T< 100ms), indicating a separate class of gamma ray bursts, which could come from primordial Black Hole evaporation. Results will be published in Astrophysical Journal letters. Cline's group also continues to work on Liquid Argon detectors in the Gran Sasso Laboratory and at FermiLab. These detectors will be crucial to understand the properties of neutrinos and the ultimate search for proton decay.

Rene Ong is working on two very high energy ground-based gamma-ray telescopes. The STACEE telescope, located at Sandia National Laboratory near Albuquerque, New Mexico, has been in total operation since 2002. This telescope detects astrophysical gamma rays at a lower energy threshold than any other ground-based instrument. In the last year, STACEE reported results from observations of several active galaxies, including the objects 3C66A, W Comae, and Markarian 421. For Markarian 421, STACEE has made the first spectral measurements of this source below 250 GeV. In May 2005, STACEE observed two gamma-ray bursts, tracking both of them for more than one hour. In one burst, STACEE started observations within three minutes of the original burst time. **Alex Jarvis** will be reporting results of these observations later this summer.

Ong and **Vladimir Vassiliev** are working on the next-generation gamma-ray telescope called VERITAS. When completed in 2006, VERITAS will consist of four 12 meter diameter telescopes, each equipped with a 500 pixel element camera. UCLA is building several major components for VERITAS, including electronics for the various trigger levels and online computing and archiving. Much of the development work is being carried out by postdoctoral researchers **Stephan Fegan** and **Amanda Weinstein**. The first VERITAS telescope has been completed and has operated very successfully since January 2005. Several gamma-ray sources have already been detected at sensitivity

The ZEPLIN II, the largest discriminating detector in the world, was recently moved underground to the Boulby mine (4,000ft deep) to start the search for dark matter.

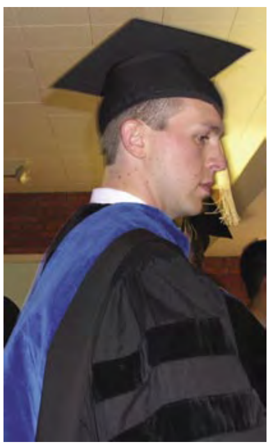


VERITAS (Very Energetic Radiation Imaging Telescope Array System) is a major new ground-based gamma-ray observatory with an array of four 12m optical reflectors for gamma-ray astronomy in the GeV - TeV energy range

levels substantially exceeding those of earlier instruments. A two telescope array was operational in October of this year. Data taken on the Crab Nebula (a supernova remnant that also contains a gamma-ray pulsar) will form the thesis of graduate student **Ozlem Celik.** UCLA is also playing a leading role in developing the scientific case for observations of dark matter sources, extragalactic galaxy clusters, and starburst galaxies to be carried out with VERITAS.

*Graduate student **Jennifer Carson** reported the results for Markarian 421 at the International Cosmic Ray Conference in August, 2005.*

Nuclear Physics



Jeffrey Wood received his PhD degree working with the Huang/Whitten/Igo research group in June 2005 based on his thesis "Polarimetry at the Brookhaven AGS Using Proton Carbon Coulomb-Nuclear Interference".

Huang Z. Huang, Charles Whitten and George Igo have been leading a prominent university group in the Solenoidal Tracker at RHIC (STAR) collaboration at the Relativistic Heavy Ion Collider (RHIC), Brookhaven National Laboratory, Long Island, New York. The research programs of the UCLA group at STAR/RHIC focus on two research areas of great current interest. One, is the study of Quantum Chromodynamics (QCD) at the high temperatures and energy densities produced in ultra relativistic nucleus-nucleus collisions, Au-Au collisions where the Au nuclei have kinetic energies of 100 GeV/nucleon, and where a new state of matter, the Quark-Gluon Plasma (QGP) predicted by QCD may be produced. The second research interest involves investigations of the contribution of gluons to the spin of the nucleon (proton) through analyses of polarized proton-polarized proton collisions – the colliding polarized (up to 65%) proton beams have kinetic energies of 100-250 GeV. For the relativistic heavy ion physics program, the UCLA analyses of STAR data emphasize the use of strange and charmed quark probes to investigate the properties of the QCD matter. Nuclear modification factors and the elliptic flow parameter for non-photonic electrons, hyperons and f mesons are being measured. To measure the gluon contribution of the proton spin the UCLA group is focusing on measurements – both protons are polarized in the longitudinal (beam) direction – of jet and non-photonic electronic production in polarized proton-proton collisions.

Condensed Matter

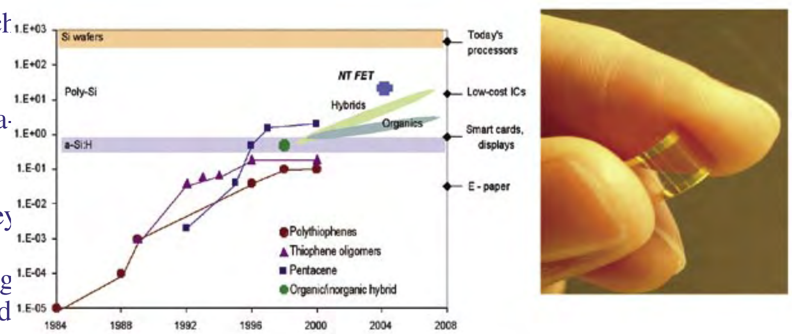
Robijn Bruinsma and **Joseph Rudnick** are continuing their investigations into the structure and life cycle of viruses, focusing on genomic packaging. In particular, they and co-workers, including graduate students and post-doctoral associates, have been looking at the energetics, mechanical properties and statistical mechanics of RNA networks. They hope to come to a better understanding of the organization of such networks in RNA viruses and how that organization influences the process of viral assembly in the host cell.

W. Gilbert Clark has carried out nuclear magnetic resonance (NMR) over a wide range of parameter space (magnetic field and temperature) on several materials this year. Investigation indicates that vibrations of the NMR coil structure are excited by the large magnetic force during the rf pulses and that these oscillations are then coupled to the sample via the contact with the liquid helium in which the sample and nearby coil are immersed. They hope to obtain a much better understanding of the inertial properties of the vortex lattice from these measurements. Another unusual property observed in this material is Radio Frequency Induced Flux Lattice Annealing (RIFLA), an effect they discovered and reported earlier [W.G. Clark et.al., J. Phys. IV Proceedings 9, Pr10-49-52 (1999)] that can occur in NbTi wires used to construct superconducting magnets. NMR measurements have been used to investigate the static and dynamic magnetic properties of the "Kagome staircase" material, $Ni_3V_2O_8$, an antiferromagnet with several unusual phases. Complex behavior has been seen in this material and further measurements and analyses are being carried out. As part of Clark's collaboration with a group at the Indian Institute of Science, Bangalore, India, NMR investigation has been carried out on the proton glass behavior in $Rb_{0.7}Tl_{0.3}H_2PO_4$, which is a mixture of antiferroelectric TlH_2PO_4 and ferroelectric RbH_2PO_4. The projects described here have been supported by NSF grants.

George Gruner's group is developing and investigating novel electronic materials and architectures. Nanoscale transistors that include novel materials constitute the technology platform that is used in the area of flexible/transparent electronics and optoelectronics. The same devices are used for electronic in vitro detection and modification of biomolecules, and for "cellectronics", the merging of cellular and electronic functions at the nanoscale. Gruner continued as chief technology officer and chief scientist of Nanomix Inc, a startup company specializing on nanoscale electronic devices developed for chemical and biosensing applications. The company has licensed one of Gruner's patents from UCLA, in the area of biosensing and it is moving toward product development utilizing the invention.

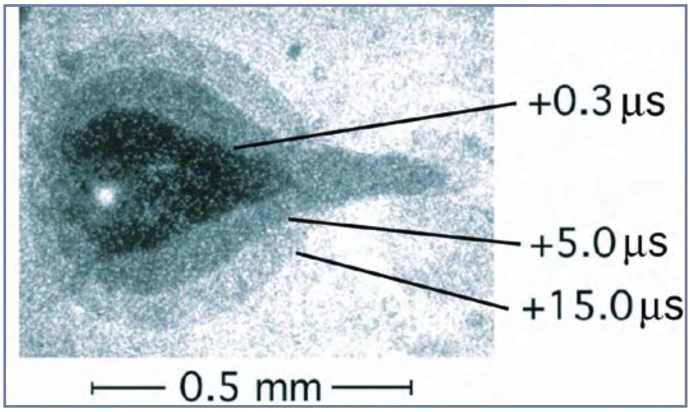
Thomas Mason's research has involved the mass production of uniform oil-in-water dispersions down to 25 nm diameters using extreme shear; (structural identification of diffusion limited aggregation of slippery droplets in attractive nanoemulsions by small angle neutron scattering). Research is also being carried out on LithoParticles; mass production of fluorescent square crosses and toroids through lithography and Microrheology; local nonlinear shear properties of crosslinked and entangled polymer solutions through optically driven rotations of birefringent microdisks).

Jianwei (John) Miao has formed a research group on 3D coherent diffraction microscopy for imaging of nanoscale materials and biological systems since joining UCLA last August. Miao and collaborators recently developed a general approach to solving the missing data problem (the intensities at the center of diffraction patterns cannot be experimentally measured), which is currently a major limitation for wider applications of coherent diffraction microscopy. They reported that, when the missing data are confined within the centro-speckle, the missing data problem can be reliably solved. By using an improved coherent xray diffraction microscope, they recorded a series of oversampled diffraction patterns from a single GaN nanoparticle at different orientations. This work in principle clears the way for single-shot imaging experiments using xray free electron lasers, which are under rapid development worldwide. Miao and collaborators have reported the development of equally-sloped tomography for the reconstruction of a 3D object from a number of 2D projections. (In a combination of pseudo-polar fast Fourier transform and the oversampling method with an iterative algorithm, equally-sloped tomography makes superior 3D reconstruction). This approach may find applications in xray imaging, electron microscopy, coherent diffraction microscopy and other tomographic imaging fields.



Transistors fabricated with a carbon nanotube network (blue cross) greatly exceed all current solutions for high mobility, flexible transistors.

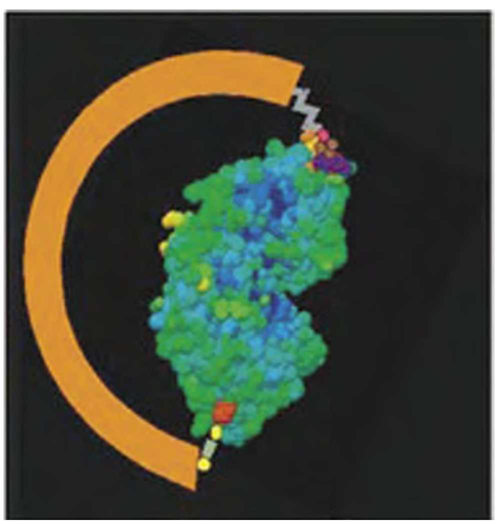
*In 2005 **Thomas Mason** received NSF Career Award*



This is a picture of a bubble that collapsed and gave off a luminescence pulse (the white dot in the center) and then developed a jet through the center of the bubble, shown by the multiple exposures at 0.3, 5, and 15 microseconds after the luminescence.

Kumar Patel and associates have undertaken an analysis of optical techniques for the detection of chemical warfare agents and toxic industrial chemicals in real-world conditions. They analyzed the problem of detecting a target species in the presence of a multitude of interferences that are often stochastic. They also provided a broadly applicable technique for evaluating the sensitivity (detection threshold), probability of false positives (PFP), and probability of false negatives (PFN) for a sensor through the illustrative example of a laser photoacoustic spectrometer (L-PAS). Substantial progress in understanding the detection of chemical warfare agents, explosives and other toxic gases in the environment has been made. For the first time, their studies, show the correct method for evaluating chemical and biological warfare agent sensor performance through appropriate ROC (receiver operation characteristics) curves. This description is now embraced by DARPA. Several papers describing the research results have been published.

Seth Putterman along with **Brian Naranjo,** and **Jim Gimzewski**, carried out research that has explored energy focusing phenomena in off equilibrium continuous systems. It turns out that fluids and solids that are driven off equilibrium do not return smoothly to the equilibrium state. Instead they can display a wide range of energy focusing phenomena. The limits of focusing are in many cases determined by processes at the nanoscale. An example is sonoluminescence where pulsating bubbles concentrate diffuse acoustic energy by 12 orders of magnitude to make picosecond flashes of light. In a one megahertz sound field the temperature inside the collapsed bubble reaches one million degrees [Physical Review Letters 92, 124301, 2004]. A compelling issue is whether the energy density becomes large enough to trigger nuclear fusion in a hydrogenated bubble. Their first attempt to observe bubble fusion was reported in a one hour documentary [October 2004] filmed in by the BBC: "An Experiment to Save the World." Although these results were negative, their project is ongoing and they predict that someone will achieve success in some region of cavitation parameter space.



Cartoon of a Protein – DNA chimera. The DNA molecular spring (orange) is stiff in the double stranded form, and exerts a mechanical stress on the protein similar to a bow pulling on its string.

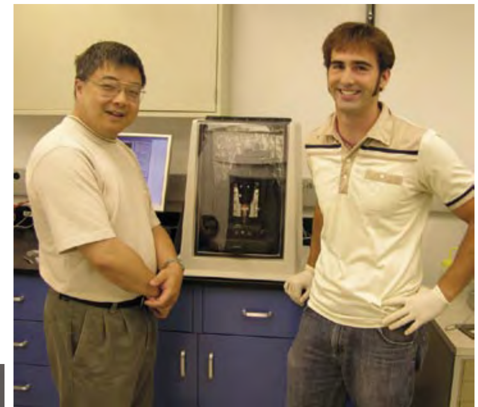
Joseph Rudnick, in collaboration with former graduate student and newly-appointed faculty member at UC Riverside, **Roya Zandi,** continues to investigate critical Casimir forces, with reference to experimental results on film thinning at the superfluid transition. Rudnick is also pursuing research on the interplay between stress and thermal effects in the denaturation of DNA.

Gary Williams' graduate student **Han-Ching Chu Czarnecka** completed her thesis investigating the nature of the superfluid phase transition of very thin helium films in one-dimensional channels. The ceramic channels she synthesized were 40 Angstroms in diameter, and the helium films adsorbed into them showed evidence of a crossover from two-dimensional superfluidity in thicker films to one-dimensional behavior in the thinnest films. Williams, in collaboration with visiting Fulbright Scholar, **Emil Brujan** from Bulgaria, carried out research on luminescence from collapsing bubbles. It was found that a bubble collapsing between two walls gives rise to a spectral line from the hydroxyl molecule in the luminescence, but not for a bubble collapsing near a single wall. This provides information on the dynamics of the jet formation, which is for a sub.

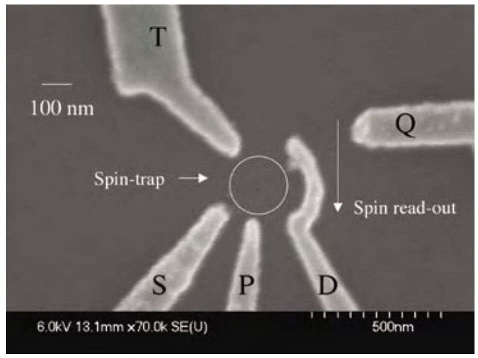
The biophysics group, led by **Giovanni Zocchi,** studies conformational changes in proteins and DNA through single-molecule and ensemble experiments. The aim is to understand the minimal design requirements for a molecular machine, and then build their own. Along these lines, they have invented a way to exert an externally controlled mechanical stress between any two chosen points on the surface of a protein. A "molecular spring" inserted on the protein exerts the stress(see figure opposite page bottom.) Presently the spring is made of DNA, and can thus control the binding affinity for a substrate by opening and closing the binding pocket on the protein's surface, through a mechanical force [Phys. Rev. Lett. 94, 038103 (2005); NSF news "A Nanoscale Mechanism for Protein Control". They are able to control the activity of an enzyme by mechanically stressing the domains that enclose the catalytic site [Phys. Rev. Lett. 95, 078102 (2005); Physical Review Focus story "Getting a handle on proteins"].

On another front, they continued the study of bubbles in DNA. Melting of the DNA double helix into separate strands proceeds through local opening of single-stranded regions ("bubbles"). Motivated by experimental measurements, they have introduced a statistical mechanics model of the DNA melting transition where base pairing and stacking are treated as separate degrees of freedom, providing a microscopic origin for the observed cooperativity of bubble opening [Phys. Rev. E 70, 051907 (2004); Phys. Rev. E 71, 041909 (2005)].

One of the major goals for the physical implementation of a quantum information processor is to develop a scalable physical system, which is capable of individual quantum state manipulations and measurements. Toward this end, **Honwen Jiang's** group in the past year, using a set of nano-fabrication tools, has fabricated an electrostatic Si quantum dot that can host a single electron spin as a quantum bit, exploiting a 2D electron gas in a strained Si layer within an epitaxial Si/SiGe heterostructure. The quantum dot is integrated with a spin-state read-out channel as illustrated in the figure below.



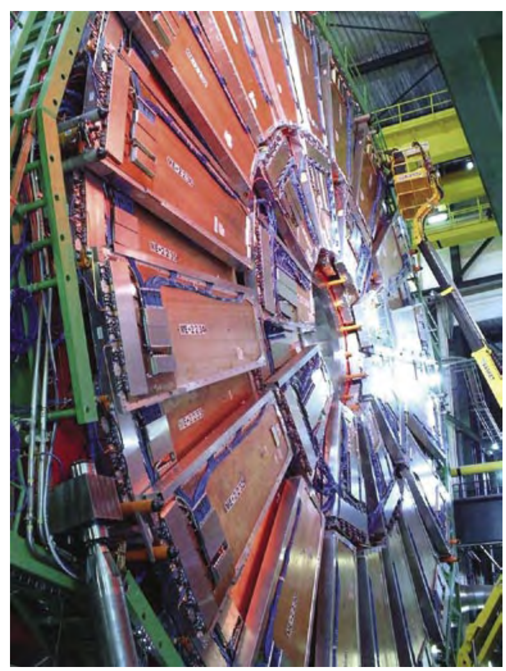
Hong-wen Jiang in lab with summer REU student Stanton Harwood, University of Oklahoma



Experimental Elementary Particles

Jay Hauser, **David Saltzberg**, and **Rainer Wallny** and their CDF (Collider Detector at Fermilab) group have recently made a number of important contributions to the study of the top quark and other particles produced in this ongoing experiment. The top quark, discovered only 10 years ago, is a fundamental particle that weighs nearly as much as a gold atom. Using sophisticated statistical techniques, graduate student **Brian Mohr** is measuring the top quark mass more precisely than any previous measurement. As critical input to the top mass measurement, postdoctoral researcher **Florencia Canelli** has determined the energy response of the experiment to light quarks and gluons. Postdoctoral researcher **Bernd Stelzer** is searching for an elusive type of collision that produces single top quarks (they are usually produced in pairs). Postdoctoral researcher **Charles Plager** is looking for an exceedingly rare type of top quark event in which a Z boson is produced rather than the usual W boson. Graduate student **Alon Attal** is likewise looking for events that, if found, would revolutionize particle physics – multi-lepton events that are predicted by a theory known as "R-parity violating Supersymmetry." Meanwhile, Wallny and graduate student **Peter Dong** have installed a small diamond detector device to instantaneously monitor radiation levels in the experiment.

Katsushi Arisaka, David Cline, Robert Cousins, Jay Hauser, and Peter Schlein have continued their work on construction of the future CMS (Compact Muon Solenoid) detector at the CERN laboratory near Geneva, Switzerland. (The CERN laboratory was highlighted in a fictionalized way in Dan Brown's recent popular book "Angels and Demons." The laboratory does not make large amounts of antimatter, nor does it own an X33 space plane that travels at Mach 17!) The CMS detector will take its first data in 2007, looking at the debris from ultra-high energy collisions of proton beams at seven times the energy available to the current CDF experiment previously



UCLA researchers work high above the ground installing the muon particle detection system of the CMS detector.

mentioned. Signals of the long-sought Higgs boson, centerpiece of physicists' understanding of nature, should be visible in the muon detectors built by UCLA and collaborators. Assistant Research Physicist **Mikhael Ignatenko** has been testing the muon detectors at CERN. Postdoctoral researchers **Martin von der Mey** and **Yangheng Zheng** have been producing large numbers of electronics boards that are used for collecting the muon data, and have been developing software to run the electronics. Research Physicist **Samim Erhan** has been developing the data collection system of CMS.

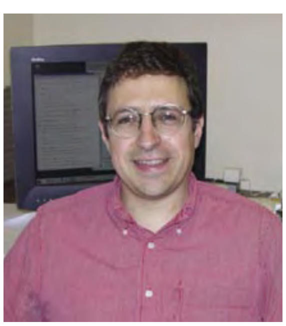
*TEP members organized two very successful international conferences this year. **Graciela Gelmini, Alexander Kusenko,** and **Roberto Peccei**, in collaboration with other physicists, organized a very stimulating workshop devoted to Dark Matter and Dark Energy in Tuscany, Italy.*

Meanwhile, preparations for analysis of CMS data are ramping up: graduate student **Jason Mumford's** Z-prime analysis and asstistant research scientist **Valery Andreev's** work on b-quark jet physics are being readied for inclusion in a large report on the physics capabilities of CMS in the near future. Postdoctoral researcher **Slava Valuev** also contributes physics and simulation studies and helps edit this report. Cline and others have studied the possible detection of Quantum Black Holes at these very high energies.

Charles Buchanan's hadronization group, including Research Physicist **Shariar Abachi** and graduate students **Brandon Hartfiel** and **Andrew Chien** have been studying the physics of how hadrons (protons, neutrons, pions, kaons, lambdas, etc) form using data of the BaBar collaboration at SLAC, Stanford. Hartfiel has finished his PhD thesis using lambdaC-antilambdaC events to produce the first direct evidence for "popcorn mesons" created from the QCD color field between a baryon and antibaryon. His evidence shows that at least in this situation, such popcorn mesons are copiously produced, averaging ~two per event. Andrew Chien is finishing his thesis on the production rates and momentum distributions of various strange baryons: lambda, sigma*, tsi, tsi*, omega-. This fundamental information will provide considerably tighter constraints on models of baryon formation.

The experimental group led by **Bernard M.K. Nefkens** has completed the first year of highly successful data taking with the Crystal Ball detector at the Mainz Microtron (MAMI) in Germany. Nefkens, one of the two leaders of this international collaboration, and his group are studying the structure of the baryons and the physics of broken symmetries. The data collected at MAMI will be used to measure the magnetic dipole moment of the Delta, an unstable excited state of the proton; (precision measurements of the mass of the eta meson and of various rare decays of the eta; and a study of the effect of the nuclear medium on matter). The group's other major project is the photo production of the doubly-strange cascade particles using the CLAS detector at Jefferson Laboratory in Newport News, Virginia. The cascade is related to the proton, but is much heavier and has two units of "strangeness." Members of the Nefkens group organized an international workshop that was held summer 2005 to outline a comprehensive experimental and theoretical program studying the physics of the cascade.

Theoretical Elementary Particles



Zvi Bern was elected a Fellow of the American Physical Society for outstanding contributions to quantum field theory

Zvi Bern's main area of research is theoretical properties of quantum field theories and their application to collider physics. In a series of recent papers together with Lance Dixon (SLAC) and David Kosower (Saclay), Bern solved a longstanding theoretical problem: how to compute leading quantum corrections to multi-particle scattering. The solution brings together ideas developed by Edward Witten (IAS) and others connected to twistor string theory with methods developed by Bern and his collaborators. The new work will have widespread applications to quantum field theories, including quantum chromodynamics and supersymmetric theories, like supergravity.

John Cornwall continues work on the center-vortex picture of quantum chromodynamics (QCD), the theory of strongly-interacting particles known as quarks and gluons. Recently he studied hybrid baryons, made of three heavy quarks and one gluon (a normal baryon, like the proton, is made of three quarks), and found excellent agreement with computer simulations of the hybrid baryon. He also studied the problem of QCD with a larger gauge group (the gauge group determines the number of gluons that exist). In this case there is more than one way of confining quarks into observable particles. By treating the center vortices as a gas of string-like objects that split and recombine, he was able to derive some results about these different ways that had so far eluded theoretical efforts.

In the past year **Per Kraus** has made progress in understanding the microscopic structure of black holes in string theory. Work with postdoc **Iosif Bena** led to the discovery of a new class of objects – black rings – which have many implications for string theory. Progress was also made in understanding black holes in the regime where there are large corrections to Einstein's theory of gravity and quantum effects are important.

Eric D'Hoker and collaborator D.H. Phong (Mathematics Columbia University) have made further breakthroughs in the understanding of one of the most fundamental aspects of superstring theory, namely its weak coupling perturbation theory, formulated in terms of fluctuating Riemann surfaces. D'Hoker and Phong have now achieved a consistent, unitary and finite formulation and explicit construction of superstring scattering amplitudes to two-loop order, which order had been the stumbling block thus far. As immediate applications, they proved a number of non-renormalization theorems, some of which had been conjectured before, and some of which were unexpected.

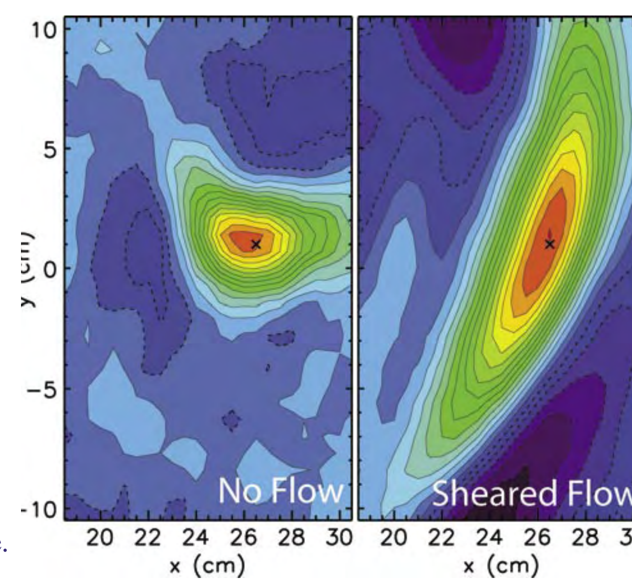
Michael Gutperle has continued the study of time dependent backgrounds in string theory, in particular he has constructed new S-brane solutions in supergravity and studied the decay of unstable D-branes using the methods of boundary conformal field theory. This work is being done in collaboration with M. Gaberdiel of ETH, Zurich and P. Yi from KIAS, Seoul. In collaboration with **E. D'Hoker** and D. Phong. Gutperle has applied the recent advances of D'Hoker and Phong in the area of two-loop perturbative string amplitudes to test various conjectures obtained from dualities.

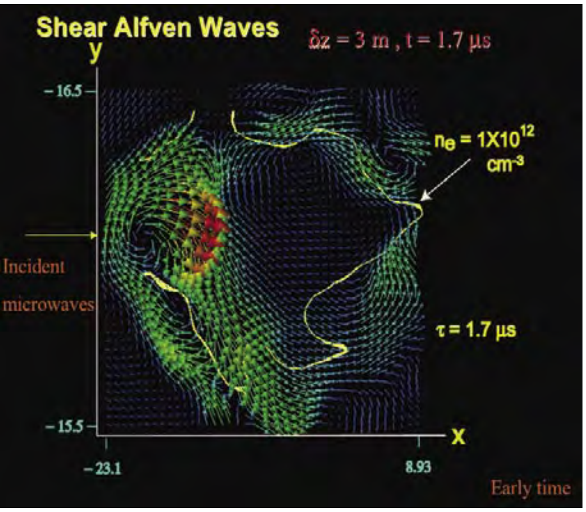
Graciela Gelmini was elected a Fellow of the American Physical Society for outstanding contributions to the theory of cosmological dark matter, neutrino mass, and the astrophysics of the highest energy cosmic rays.

John M. Cornwall was elected a Fellow of the American Physical Society for pioneering work in understanding non-perturbative aspects of gauge theory.

Plasma and Advanced Accelerators

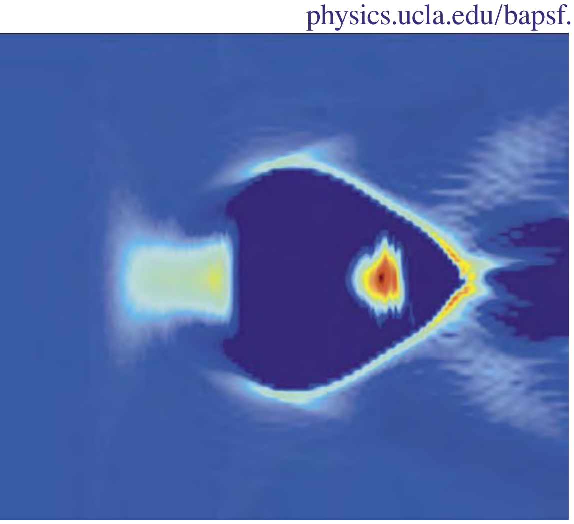
Troy Carter and colleagues are investigating nonlinear interactions between shear Alfv\'{e}n waves and suppression of turbulence and cross-magnetic-field transport by sheared flows. These studies are being performed on the Large Plasma Device (LAPD), part of the Basic Plasma Science Facility (BAPSF) at UCLA. From a weak turbulence point of view, nonlinear interactions between shear Alfv\'{e}n waves are responsible for the cascade of energy across spatial scales in low frequency turbulence in magnetized plasmas. Interactions between large amplitude shear Alfv\'{e}n waves are being investigated, in particular a co-propagating beat-wave interaction which is consistent with stimulated modulational instability. During this interaction, a low-frequency density perturbation is driven at the beat frequency, which in turn scatters the incident Alfv\'{e}n waves, generating a series of sidebands. Carter, **James Maggs** and **Robert Taylor,** are studying the formation of particle transport barriers in LAPD in the presence of sheared cross-field flows. The experiments in LAPD have revealed that transport suppression is achieved through the modification of the cross-phase between density and potential fluctuations in the turbulenceDetailed two-dimensional correlation functions have been measured, showing that while the azimuthal correlation increases dramatically, significant radial decorrelation is not observed, contrary to some theories of shear suppression of turbulence.





The magnetic field of Alfven waves which result in a high power microwave experiment. The resonance location is indicated by the yellow line.

The LAPD research group led by **Walter Gekelman** and **James Maggs,** has had an exceptional year in the Basic Plasma Science Facility (BAPSF)**.** A comprehensive site review in June 2005 resulted in a renewal of funding with a forty percent increase. BAPSF) provides plasma scientists with a unique leading edge device, the Large Plasma Device (LAPD). Plasma problems spanning a broad range of spectral, spatial, and temporal scales are studied. The LAPD's design provides for experiments not possible in small scale linear devices or impracticable in large fusion facilities. The only national user facility of its kind, 50% of the LAPD's run-time was utilized by visiting scientists. The LAPD local group has a number of research projects being undertaken by the research staff, faculty and graduate students (**Brett Jacobs, Andrew Colette, Eric Lawrence, and Chris Cooper, Bart Van Compernolle**). Graduate student Bart Van Compernolle's doctoral thesis involves an experiment in which an intense microwave pulse (1000kW, 2.5 μs, 9 Ghz0 was propagated across the magnetic field in the LAPD device. The thesis consists of a detailed experimental study of the wave generation in both the X and O mode cases, as well as a theoretical study. All research as well as all work done by the LAPD group and outside users can be accessed at the BAPSF website http://www.plasma.physics.ucla.edu/bapsf. Gekelman together, with senior scientists from Novellus were awarded a Cal MICRO grant worth $100,000. The funds will be used to set up a lab and fund a graduate student geared specifically to advancing the science of low density, low temperature, and RF plasmas used in this field. The Novellus Corporation, a large company that manufactures the tools used in making semiconductors and computer chips, donated to the lab a plasma processing tool valued at over one million dollars.



An electron beam moving from right to left blows plasma electrons out creating a wakefield that accelerates a trailing beam of electrons. These results are from a QuickPIC simulation that was run on the Dawson cluster.

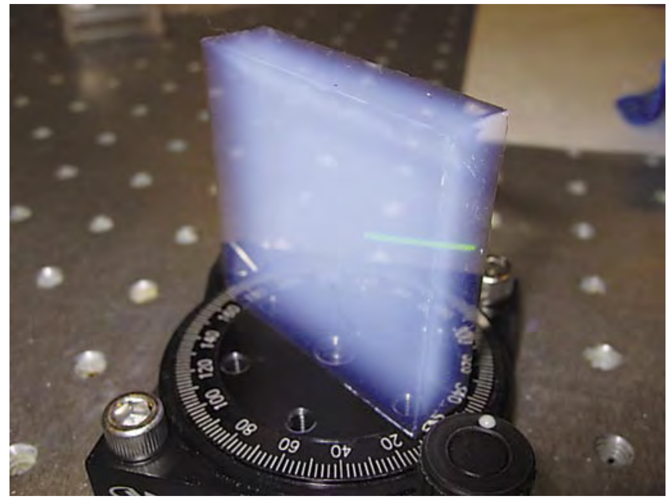
The Computer Simulations of Plasma Group under the leadership of **Warren B. Mori, Jean-Noel Leboeuf, Viktor Decyk,** and **Phil Pritchett** continues to do pioneering work in high-performance computing of complex plasma phenomena. The group includes four junior researchers and seven PhD students. Research is focused on the use of fully parallelized particle based simulation models to study magnetically confined plasmas, laser and beam plasma interactions, space plasmas, Alfvenic plasmas, and high-energy density science. The group has developed and maintains over six separate state-of-the-art simulation codes including OSIRIS, UPIC, UCAN, Summit Framework, Recon3d, QPIC, and QuickPIC. Recent highlights include using the gyrokinetic particle-in-cell (PIC) codes UCAN and Summit to validate several critical concepts in magnetic fusion by thorough comparisons with DIII-D (a tokamak at General Atomics) experiments. The group has been conducting research to determine the feasibility of an energy doubler or so called "afterburner" for an existing or future linear collider. They have also been carrying out full-scale simulations of experiments being conducted at the Stanford Linear Accelerator (SLAC) in collaboration with Stanford, UCLA, and USC. These simulations use OSIRIS and QuickPIC and they support the experimental observations of 3 GeV energy gain in only a few centimeters. Other topics being studied by the simulation group are the feasibility of the fast ignition fusion concept as well as laser-plasma interactions relevant to the National Ignition Facility. They are also carrying out PIC simulations of how Petawatt lasers couple to nearly solid density plasmas as well as how lasers are used to compress the fuel. Much of the simulations are done on the group's DAWSON Cluster.

The Particle Beam Physics Laboratory (PBPL) under the leadership of **James Rosenzweig and Claudio Pellegrini,** has continued its exploration of the frontiers of accelerators and beam physics. This year has seen the completion of several major experiments in advanced acceleration and light source techniques: Inverse Free Electron Laser (UCLA), Plasma Lens (FNAL), VISA II Free-Electron Laser (BNL). These experiments, as well as related theoretical and computational efforts, have led a series of high profile publications. This year a number of new projects have begun. An ambitious new experiment at the on-campus Neptune laboratory is based on an Inverse Compton Scattering (ICS) source that produces xrays using a powerful laser colliding with a relativistic electron beam. The ICS is relevant to future particle colliders, and xray generation for material studies and medical applications. A new experiment at SLAC is studying the breakdown of dielectric materials under extreme electric fields (GV/m) to understand their applicability to advanced accelerators. Cutting edge collaborative experiments in high brightness beams and free-electron lasers, under continuing Department of Energy, and new NSF support, are now beginning at both Stanford and Frascati (Italy). And, the installation of a new computing cluster at PBPL is enabling simulations of the revolutionary LCLS x-ray FEL originally proposed by Pellegrini and now under construction at SLAC.

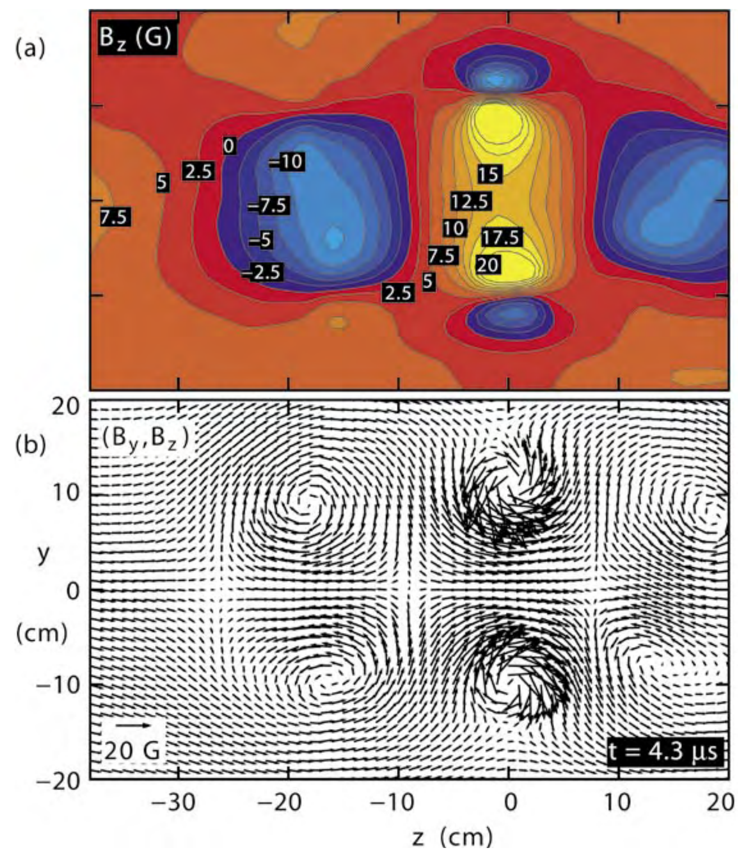
With the completion of PAB, the PBPL was able to occupy a new office suite on the third floor of Knudsen Hall, thus providing critical mass for the group. They are also happy to announce that **Gil Travish,** formerly a senior developmental scientist, has obtained a permanent position as a associate researcher.

The Basic Plasma Research group led by **Reiner Stenzel and J. Manuel Urrutia,** with funding from the National Science Foundation, has conducted research that has led to the discovery of whistler waves with wave magnetic fields exceeding the background magnetic field. Such extremely large waves create magnetic null points which should prevent the wave to propagate. Instead, the null points move with the wave packet at the whistler speed. The field topology is that of a three-dimensional vortex (Hills vortex or spheromak). Strong electron heating is observed in these waves, which propagate slower than the electron thermal velocity. The group has received a new research contract from the U.S.Air Force on the interaction of whistler waves with energetic electrons, studying nonlinear wave-particle interactions. With magnetic antennas we have already succeeded to inject 40kW of whistler wave energy into our laboratory plasma and observed significant electron scattering.

*In 2005, **Andrea Ghez, Alexander Kusenko,** and **Chetan Nayak** were elected general members of the Aspen Center for Physics (ACP) for the standard term of five years.*



Aerogel — "liquid smoke" — a solid with the density of gas is being prepared for use as an electron beam diagnostic. A green laser is passing through one corner to measure the index of refraction. The blue glow is caused by the camera flash.



Snapshot of the field properties of "whistler spheromaks" at a time when the coil current produces a magnetic field opposite the ambient field. (a) Magnetic field component $B_z(0, y, z)$ showing field-reversal regions near $z \simeq \pm 15$ cm from the coil. (b) Vector field (*By,Bz*) showing the field topology projected into the y–z plane. The coil is located at $z = 0$, the spheromaks are at $z \simeq \pm 15$ cm.

Faculty 2004 – 2005

Professor

Ernest S. Abers
Katsushi Arisaka
Maha Ashour-Abdalla
Eric Becklin
Zvi Bern
Stuart Brown
Robijn Bruinsma
Charles Buchanan
Vice Chair Academic Affairs
Sudip Chakravarty
David Cline
Ferdinand V. Coroniti
Vice Chair for Astronomy and Astrophysics
Robert Cousins
Steven Cowley
Eric D'hoker
Douglas Durian
Sergio Ferrara
Christian Fronsdal
Walter Gekelman
Graciela Gelmini
Andrea Ghez
George Grüner
Jay Hauser
Kàroly Holczer
Hong-Wen Jiang
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Ian Mclean
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Seth J. Putterman
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Chair of Physics and Astronomy
Peter E. Schlein
William E. Slater
Vice Chair Resources
Reiner Stenzel
Terry Tomboulis
Jean Turner
Roger Ulrich
Charles A. Whitten
Gary A. Williams
Alfred Y. Wong
Retired 11/04
Chun Wa Wong
Edward Wright
Benjamin Zuckerman
Retired 11/04

Associate Professor

Huan Huang
Alexander Kusenko
James Larkin
Chetan Nayak
David Saltzberg

Assistant Professor

Troy Carter
Michael Gutperle
Brad Hansen
Per Kraus
Vladimir Vassiliev
Rainer Wallny
Giovanni Zocchi

Professor Emeritus

Rubin Braunstein
Nina Byers
Marvin Chester
Gilbert W. Clark
John M. Cornwall
Robert Finkelstein
Roy Haddock
George Igo
Leon Knopoff
Steven Moszkowski
Richard Norton
Mirek Plavec
David Saxon
Eugene Wong
Byron T. Wright

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Samim Erhan
Jean Noel Le Boeuf
Anthony Lin
James Maggs
William Peebles
Philip Pritchett
R. Michael Rich
Robert Taylor
Steven Trentalange
J. Manuel Urrutia
Mahmoud Youssef

Associate Researcher

Richard Edelson
Vahe Ghazikhanian
Michael Lindgren
Neil Morley
L. Ravi Narasimham
Terry Rhodes
Lothar Schmitz
Ferenc Varadi
Hanguo Wang

Assistant Researcher

Shahriar Abachi
Luca Bertello
Yasuo Fukui
Jean-Luc Gauvreau
Mark Gilmore
Mikhaeil Ignatenko
David Leneman
Sven Reiche
Chuang Ren
Glenn Rosenthal
Shoko Sakai
Aran Tripathi
Frank Tsung
Stephen Vincena
Hanguo Wang
Feng Zhou
Jeffrey Zweerink

The important thing is to not stop questioning.

. . . . . .Einstein

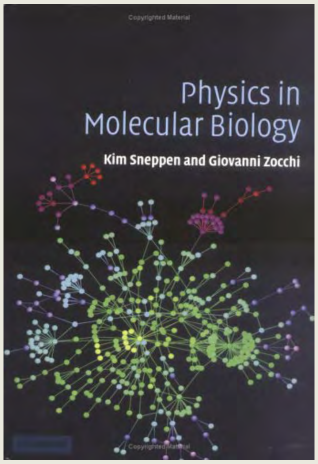
Education Highlights

Graduate student Erin Smith working in the IR Lab clean room on optical components for FLITECAM. Erin won a hard-to-get (1 in 10 chance) NASA Graduate Student Research Fellowship.

Stuart Brown shows summer REU student Mike Curtis the ropes

Graduation Day June 2005

Books Published by Faculty



"Physics in Molecular Biology",

by Kim Sneppen and Giovanni Zocchi, published by Cambridge University Press in August 2005.

Gerard ‘t Hooft

Saxon Lecture 2004-2005

Nobel Laureate 1999 and Professor of Theoretical Physics, Gerard ‘t Hooft, Utrecht University, Holland was the guest speaker for the 2004 - 2005 Saxon Lecture which was on Thursday, September 30, 2004. Professor ‘t Hooft’s talk was on “Black Holes and the Information Paradox”.

Kinsey Hall/Humanities

In 2005 repairs and renovations started on Kinsey Hall, which will be renamed the Humanities Building. Kinsey Hall was originally known as the physics-biology building, and in 1964 was dedicated to honor Edgar Lee Kinsey, professor of physics and former chair of the department. With the construction of the new physics and astronomy building Kinsey Hall has been designated for humanities and will be renamed. Kinsey Hall housed the physics library, which has been moved to the chemistry building.

2005 - Looking east from what was once the Physics Library

Final days of physics library taken in 2003 just before Kinsey Hall renovations

Research Experience for Undergraduates

Camping trip to the Sierras

Summer 2005 saw the third year of the Research Experience for Undergraduates program sponsored by NSF. Thirteen students coming from every corner of the country assembled in our department for an intensive 10-week immersion in research supervised by some of our best faculty. Each student collaborated with his/her faculty mentor on a well-defined research project and participated in academic and social activities all aimed at giving the students a taste of what a research career might be and a sense of science as a community. The program is challenging as the students present the results of their research at an end-of-program symposium and write a paper written in a professional format but the environment is supportive and the activities balanced, complete with a two-day hiking trip in the Sierras. Students discover UCLA through the process and more specifically what the department of Physics & Astronomy has to offer and many express an interest in coming back for graduate school.

NSF-Sponsored Outreach

The UCLA Plasma Science and Technology Institute continues to engage in outreach to underserved populations. For the third year, they have participated in the Celebra la Ciencia science fair held immediately after the Cesar Chavez Memorial March in the city of San Fernando on April 3, 2005. This time, J. Manuel Urrutia was joined by Charles Whitten and Troy Carter, research faculty members Jean-Noel LeBoeuf, Phillip Prittchett, Frank Tsung, and graduate students James Kniep and Jay Fahlen. As in previous years, hands-on physics demonstrations were offered to much interest from the attending families. Celebra la Ciencia, a Washington, DC-based group has been funded by NSF to promote “informal science learning” in different areas of the country and has formed a coalition with various Los Angeles institutions to introduce scientific concepts outside of formal settings. The Los Angeles coalition is the only one with an academic component. As a result of this and other outreach activities, Urrutia was asked by the campus’ Center for Community College Partnerships to be a participant in their Summer Intensive Transfer Experience program. Urrutia, together with George Morales and Jean-Noel LeBouef, held a 2 hour lecture/demonstration session with twenty transfer students on July 20, as well as a tour of Reiner Stenzel’s laboratory. The students were favorably impressed by the presentation and several expressed interest in pursuing careers in science. For more information on the outreach program, go to our website at: http://www.physics.ucla.edu/plasma-exp/outreach/index.html

Manuel Urrutia and Jean Noel LeBouef during outreach demonstration

Eric D’Hoker has developed a “Scientific Writing Course” into a quarter-length class.

GAANN Fellowship Recipients

The Department was granted a fellowship from the U.S. Department of Education through the Graduate Assistance in Areas of National Need (GAANN) Program. Through this fellowship program, the department was able to support eight incoming graduate students. The selection criteria for this prestigious fellowship program is competitive and based on financial-need and academic ranking. The recipients of this award for 2005-2006 are: **Andrew Forrester, Andrey Knyazik, Sean Lake, Jason Ma, Erika Nelson, Jordan Tucker, Andrew Wang** and **Jeff Wright**. Recipients of the GAANN Fellowship are encouraged to seek out research opportunities earlier in the PhD program and are required to participate in a Scientific Writing Course with Prof. E. D'Hoker during the Spring Quarter

Dissertation-Year Fellowship Program

The University of California's Dissertation-Year Fellowship Program provides support to outstanding PhD candidates during their dissertation year. The program is designed to identify doctoral candidates who have been educationally or economically disadvantaged or whose research or planned career direction focuses on problems relating to disadvantaged segments of society. The program assists these students by providing faculty mentorship as well as information and advice as they prepare to become postdoctoral fellows or candidates for faculty positions. Each year, 52 Fellows are selected competitively by the Graduate Division of the nine UC campuses. This year four dissertation year Fellows have been selected from the physics and astronomy department. They are: **Brian Choi, Erin Hicks, Seth Hornstein, Adrian Soldatenko**

The Physics 4BL course has been modernized. Many new experiments have been designed, built and used by the students. The lab manual is available on the web (http://www.physics.ucla.edu/class/eternal/4BL_STENZEL/notes/4BL-manual-html/index.html).

New Faculty arriving July 2005

Dolores Bozovic received her undergraduate degree at Stanford University, majoring in Physics and with research experience in biophysics. From there, she went on to the Physics department at Harvard University, where she obtained a PhD. Her graduate work was in the field of mesoscopics, focusing on electron properties of carbon nanotubes. Dolores pursued further her interest in biological physics, as a Postdoctoral Associate at Rockefeller University, in the laboratory of Dr. A. J. Hudspeth. There, she studied the processes underlying our sense of hearing, particularly the role of inner ear hair cells in the detection and analysis of sound waves. Bozovic plans to continue this line of research here at UCLA, at the interface between physics and sensory neuroscience.


Dolores Bozovic

B. Chris Regan received his undergraduate degree at Stanford University, majoring in physics and received his PhD in physics from UC Berkeley. He did a postdoctoral fellowship with the Zettl group at Berkeley. In 2004-2005 Chris was the acting executive director, Center of Integrated Nanomechanical Systems (COINS). In the past Chris has used atomic physics methods to look for violation of time-reversal symmetry, which relates to the observed preponderance of matter over antimatter in the universe and extensions to the Standard Model of particle physics. More recently he has been studying the properties and device applications of exotic materials, ranging from superconductors to nanotubes. He is currently using the tools of nanotechnology to look at problems of both fundamental and practical interest. Specific projects are relevant to cosmology, quantum optics, nanoscale self-assembly, and clean energy harvesting.


B. Chris Regan

REMEMBERING A CHAMPION OF COMPASSION **Daniel Byram May** (1975--2002) Daniel exuberantly revived the Undergraduate Physics Society. He assisted in the development of an intra-operative imaging beta probe, helped with free electron laser research, tutored in physics, wrote a lecture note supplement, and graded homework. He was also a counselor for UniCamp and part of the UCLA Marching Band. He graduated with Departmantal Honors (B.S./ Physics) and received Chancellor's Service Award in 1996. After graduating, Daniel designed a course on compassion for the UCLA curriculum. While an ESL teacher in Compton, he took 9 top students to Disneyland in a limousine. He created a website ("AngelsWeekly.com") which reported only good deeds via its online newsletter. All along, he was a devoted member of Self Realization Fellowship, which he served extensively in various capacities–while maintaining ties to his Zoroastrian heritage.

Bachelor of Science Degrees Awarded

Astronomy

Altenbach, Fabio
• Charles Geoffrey Hilton Astronomy Award
• Full fellowship to pursue graduate studies in Astro-physics at Caltech
Dahlberg, Jennifer
• Full fellowship to pursue graduate studies in Forensic Science at U. of Central Oklahoma
Eramya, Allen
Gigliotti, Alex
• E. Lee Kinsey Senior Award
Lopez, Francisco
Naiman, Jill
• Charles Geoffrey Hilton Astronomy Award
Pak, Frances
Sato, Kenichiro
Silvers Tatiana
Trejo, Arturo
Turetsky, Yury

Physics

Ambroso, Michael
• Full fellowship to pursue graduate studies in physics at U. Penn
Badakov, Hristo
Barsi, Christopher
Bhatti, Waqas
• Full fellowship to pursue graduate studies in Astronomy at Johns Hopkins
Brewer, Mary
Cervantes, Carolina
Chan, Vincent
Danino, Tal
Dugaiczyk, Lars
Dunworth, Jeffrey
• Full fellowship to pursue graduate studies in Physics at UCSD
Eagle, Ryan
• Full fellowship to pursue graduate studies in Physics at Georgia Tech Institute
Ellyin, Raymond
Ettema, Taylor
Garnica, Ricardo
Glasser, Ryan
• Full fellowship to pursue physics at Louisiana State University at Baton Rouge
Gomon, Vyacheslav
Gutierrez, Christopher
Hsu, david
• Full fellowship to pursue physics at UCI
Huver, Sean
• Full fellowship to pursue physics at Louisiana State Unversity at Baton Rouge
Ibrahim, Khadeejah
Kakiuchi, Madoka
Lee, Frank
• Full fellowship to pursue Electrical Engineering at UCSD
Lee, Han Kyu
Lim, Van Vincent
Mcbarron, Alicia
McGough, Sophie
O'Shea, Brandon
Ribnik, Jacob
• Full fellowship to pursue physics at UCSB
Rogers, Matt
Schopf, Eric
• Full fellowship to pursue mechanical engineering at UCLA
Seaver, Robert
Shin, Steven
Tao, Ted
• E. Lee Kinsey Senior Award
• Full fellowship to pursue physics at UCSB
Taylor, Douglas
Teng, Shiang-Jen
Topchyan, Christina
• Full fellowship to pursue physics at UCI
Trestrail, Akire.
Ueda, Alex
Velasco, Noel
Vergara, Alfonso
Visher, Rex
Vuong, Hsun-Yu
Watson, Kyle
Woodruff, Jason
Wright, Jeffrey
Wright, Nathan
• Full fellowship to pursue physics at San Diego State University
Yoshida, Hirofumi
Young, Justin

Bachelor of Arts Degrees Awarded

Mcbarron, Alicia

Doctoral Degrees Awarded

Astronomy

Sarah Lipscy
• Outstanding TA Award 2002-2003
Amy Lo
• Cota Robles Award
• Outstanding TA Award 1999-2000
• RA Mentorship Award
Caer-Eve McCabe
• Outstanding TA Award 1998-1999
Joseph Rhee
Michael Schwartz

Astrophysics

Jay Farihi

Experimental Accelerator Physics

Pietro Musumeci
Kip Bishofberger

Experimental Condensed Matter

Han-Ching Czarnecka
Ming Xiao

Experimental Plasma Physics

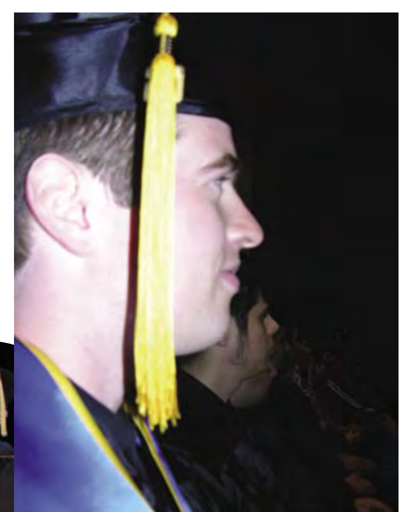
Nathan Palmer

Theoretical Condensed Matter Physics

Weiqiang Yu

Theoretical Elementary Particle Physics

Masaki Shigemori
Lee Loveridge
• Outstanding TA Award 2001-2002
• Dissertation Year Fellowship 2004-2005
• PAAL Award 2004-2005



Theoretical Plasma Physics

Gregory Howes
• Dissertation Year Fellowship 2001-2002

UCLA Physics and Astronomy Department
2004 - 2005
Chair
Joseph A. Rudnick

Editor
Mary Jo Robertson

Feature Article
Barbara Pawley

Contributing Editors
Francoise Queval, Jenny Lee, Manuel Urrutia, Joseph Rudnick

Design
Mary Jo Robertson

This report covers the period July 1, 2004, through June 30, 2005.

For more information on the Department see our website:
<http://home.physics.ucla.edu>

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