UCLA

Department of Physics & Astronomy

Annual Report 2003 - 2004

Department of Physics & Astronomy 2003-2004

University of California, Los Angeles

Physics and Astronomy Department
2003 - 2004

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Artists rendering of a black hole

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This has been quite a year for our department. The new Physics and Astronomy building, displayed on the cover of this annual report is about to become a reality. As we write this letter, the Astronomy faculty is completing its move into the new offices. Our plasma physics and theoretical elementary particle groups have already settled into their new quarters. By the beginning of the school year, students will he taking classes in two lecture halls in that building, both of them containing state-of-the-art audio-visual equipment. The larger hall sports a rotating demonstration area, that will allow for the preparation of lecture demonstrations and their rapid positioning into the lecture hall. A celebration of this new and beautiful annex will occur on November 13, 2004. We are happy to invite our alumni and friends to this happy occasion.

The new building is not the only physical improvement that we can report. As part of the relocation process, new labs have been installed in Knudsen Hall for the use of undergraduate students taking our introductory courses. These labs incorporate the best equipment that an aspiring young scientist could hope to utilize. Additionally, the Leonard Lounge (since 1973 the room in which students, faculty and staff have relaxed, mingled and celebrated) has seen a renovation that both enlivens and enhances it.

Joseph Rudnick, Chair
2004-2005

Not all developments have been positive. The Physics and Astronomy Department has now vacated its historical home, Kinsey Hall. As part of this move, the physics library, a treasured resource, has had to relocate. Some of its contents are now in the library of the Department of Chemistry and Biochemistry. The remainder has been dispersed to other libraries, and to storage. In addition to the outstanding collection of books and journals, the library also provided students, faculty and researchers a haven in which they were able to study and contemplate in peace and quiet. We have managed to compensate for this loss in part by creating new space for our graduate students. However, a long-term goal of all of us here is the reconstitution of our collection and the reintroduction of associated study space.

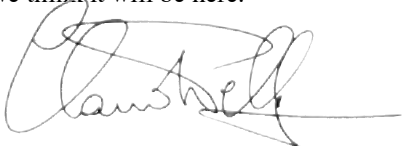
Ferdinand Coroniti, Vice-Chair
2004-2005

As an important educational development, the Department of Physics and Astronomy is now pleased to offer to motivated undergraduates the new biophysics major. This new major grounds the student in fundamental physics and also introduces him or her to the essential fund of knowledge and set of tools required to appreciate the big questions in biology. In this way, we will equip a group of students to begin exploration into the burgeoning field of biological physics.

We are also delighted to welcome three new faculty members. Professor Vladimir Vassiliev works in the field of experimental astrophysics. His work complements the efforts of Professors Arisaka and Ong in a field of astronomy that holds the promise of discoveries related to the dark matter problem, as well as issues related to fundamental physics symmetries up to the quantum gravity energy scale. Professor Jianwei (John) Miao was recruited to the department in conjunction with the newly instituted California Nano Systems Institute (CNSI), a visionary UCLA-based research enterprise funded by the state of California to foster fundamental advances in the understanding and exploitation of processes on the nanoscale. Finally, we are pleased to welcome to UCLA Professor Tom Mason, a widely-recognized expert on the properties of complex fluids. While his primary appointment is in the Department of Chemistry and Biochemistry, Professor Mason has a strong affiliation with the Department of Physics and Astronomy. More detailed profiles of all our new faculty appear in the body of this report.

Finally, we are proud to bring your attention to two pieces of information about UCLA in general. First, UCLA placed in the top 20 of a recently released survey of the ranking of academic institutions world-wide. Specifically, we are ranked 16th. The survey, carried out by Shanghai Jiao Tong University, took into account the quality of the education provided, the excellence of the faculty, and the research output of the institution. Rankings are posted at the web address *http://ed.sjtu.edu.cn/ranking.htm*. With regard to external evaluations of our research effort, it is also worth noting that UCLA is now ranked #1 nationally in terms of total amount of external research funding awarded to faculty, staff and students.

We hope that you will read and enjoy this annual report. Whatever your association with UCLA and our department, we look forward to your continued involvement. We value your commitment to the future of education, and we look forward to a future that is as exciting for you as we think it will be here.



Graduate Student Life at UCLA

The success that the Department of Physics and Astronomy enjoys and its reputation in the field is, to a large extent, associated with the quality of its graduate students and the nature of the relationship that exists between graduate students and the faculty. The road from beginning graduate student to newly minted Ph.D. can have its share of bends and detours. The goal of the department is to have graduate students and faculty working together to produce new generations of scholars who are trained at the highest level and armed with the intellectual and scholarly tools to go forth and further the limits of our knowledge in the fields of physics and astronomy. It has been argued that to do so, graduate students must have not only the intellectual wherewithal to investigate their fields, but also the sort of passionate curiosity that drives them to investigate, to the *n*th degree, areas of science that most of the world does not even know exist.

" I did a summer program at a plasma lab and found the subject very interesting. UCLA has a fantastic, and still growing, plasma program. I joined the ET group because they can help me become an expert in this field by providing the type of hands-on experience that most graduate students simply never get while in school."
(David Pace)

Different circumstances and the difficulties inherent in any graduate program begs the question, what is it that motivates these graduate students to pursue years of graduate study? The answers here at UCLA are as varied as the number of graduate students enrolled, but when graduate students are queried, there seems to be certain motifs that recur in their answers. A sampling of responses from graduate students suggests that primary motivation centers around intellectual curiosity and the satisfaction that comes with the exploration of their field:

- *"I chose astrophysics. Rather, astrophysics chose me. I like the way it combines all the different aspects of physics together, while remaining philosophically interesting and aesthetically pleasing."*

- *"I always had an interest in science since a young age. That, combined with a reductionist viewpoint on the natural world and a derived sense of enjoyment from doing math, left physics as the obvious choice."*

- *"I took physics in high school and fell in love with its ability to explain everything around us."*

- *"I was pretty much born to the profession. I thought I might want to be a physicist ever since high school."*

- *"Studying physics helps... [to] understand the fundamental nature of reality."*

- *"I wanted to understand how things worked, and in that I could not settle for half answers, I wanted to know the whole truth... ."*

"Although I came in with a physics major, I did X-ray pulsar astronomy research as an undergraduate. My astro interests have always tended to stellar astronomy and in particular extreme stellar astronomy (black holes, neutron stars, and now galactic center.)"
(Jessica Lu)

Electric Tokamak grad students left to right:
Travis Yates,David Pace, David Lafonteese, Anne White

"I decided to accept UCLA's graduate offer because of the Electric Tokamak (ET) Lab. During my final year as an undergraduate I became interested in plasma physics and tokamaks specifically. The ET lab here offers one of the best machines for this study. UCLA then made it possible for me to begin working in the lab immediately after my graduation while other schools were not always able to do the same. In every important respect: people, lab opportunity, and research prestige, UCLA is superior to the other schools I considered."

The life of a graduate student is inherently one of contradiction. Having just completed undergraduate training, the new graduate student is nonetheless expected to perform at the highest of scholarly levels. At a time when peers are entering into the workforce and reaping the financial and career benefits of their undergraduate education, those who choose to attend graduate school are, in contrast, preparing to embark upon what is in some respects a semi-monastic period of study and research, a period which will in all probability be as long, if not longer, than their undergraduate years. They will do so in exchange for what can only be termed a modest stipend, certainly much, much less than their science degrees would have brought them on the outside. The newly arrived graduate student soon finds that graduate school demands new ways of thinking: no longer is it sufficient to commit great quantities of information to memory and have a moderate ability to interpret these data. While the acquisition of new information is an important part of graduate study, it quickly gives way in importance to knowing how to approach the information, how to work it, how to interpret and challenge it. Incoming graduate students are asked to adopt new modes of thinking, to move beyond the black and white of memorization of fact into the many shades of intellectual gray.

Sarah Lipscy astronomy graduate student at the Keck Laboratory in Hawaii

The role of faculty is fundamental to this process. The relationship between graduate student and faculty is often complex and characterized by a degree of intedepend-ency much stronger than exists between faculty and undergraduate students. As the typical graduate student progresses through the program, the nature of this special relationship begins the subtle shift from that of student and teacher to that of future colleague and mentor. With the maturing of this relationship comes a shifting of balance and the establishment of a partial symbiosis: the graduate student is, of course, still very much dependent upon the guidance and support of his or her mentor, but at the same time begins to contribute more and more to the that mentor's own research as a part of the research team. It is only the mutual dedication of graduate student and faculty member alike to this long and complicated process that new scholars emerge.

As an academic entity, the department feels itself fortunate to be in a position to recruit young scholars who display such a deep sense of intellectual curiosity. According to graduate students themselves, what attracted them to UCLA to do their graduate work in physics and astronomy is a combination of the programs over all strength and breadth, along with the opportunity to work with prominent faculty in the field. That the department, in addition to astronomy/astrophysics, has five separate physics subgroups, played a significant role in the decision of many of our graduate students who opted to study at UCLA. It offers them a degree of flexibility not seen in all graduate programs, and thus affords them greater academic opportunity and lessens the pressure to immediately choose a specific concentration within the field. In addition, this wide array of options makes possible the luxury of changing concentrations should they feel the need to do so at some point in their studies. The facilities and labs available to graduate students are also significant factors in attracting high quality students to the program.

Theoretical Elementary Particle grad student **Lee Loveridge**

The Pressures

For all the idealism and enthusiasm expressed by these students, the fact remains that this department, like any, is no mythical, academic Shangri La. Tension is an inescapable part of a graduate student's life, usually a result of the academic obligations of his or her specific academic program, but frequently brought on by the same factors that make life in Los Angeles so

Astronomy graduate students Matthew Barczys and Seth Hornstein, at the top of Haleakala in Maui, Hawaii while at the Professional Development Workshop sponsered by the Center for Adaptive Optics (CfAO)

challenging, is the high cost of living, the traffic situation, etc. While many students immediately find their niche, not all do. Some find they need to change advisors or even change academic concentrations. UCLA is one of a few major research institutions still operating on the quarter system (as opposed to the more common—and many would say less stressful semester system), which can be the cause of no small amount of tension. When combined with the fact that the academic program here is rigorous, the standards are high, and the demands placed on graduate students to perform are immediate, the picture of the high-pressured environment that awaits graduate students quickly comes into focus.

Leisure Activities

This is not to say, that students never find time to break from their studies and have a life outside the Department. Indeed, in programs that can last five or six years, it is essential that students make the time to socialize and get away, a juggling act that most have mastered during their tenure here. Los Angeles has a great many options, and nowhere more than in the area of entertainment. Graduate students frequently take advantage of the large number of movie theaters located near campus in Westwood. Other recreational opportunities commonly mentioned by the graduate students are the clubs along Sunset Boulevard and Melrose, the many live theaters found in Los Angeles, and the diverse choice of restaurants.
In spite of the high cost of living in Los Angeles, there are a number of recreational options here that are quite affordable, if not cost-free. There is camping in the near-by national forests, hiking and bike-riding in the Santa Monica mountains, the many beaches, and near-by museums including the Getty Center. Many of the students also take part in the intramural programs and athletic facilities available through UCLA.

Socialization Process

During the first year or year and a half of graduate school, during the time in which students are preparing for their comprehensive exams, social life tends to be restricted primarily to one's core of acquaintances within the department. After this period, however, as students branch into their specialties and come to know the local area better, the inclination is for this sphere to broaden widely, to include students in other departments and even those not connected to the UCLA. Most graduate students, as a part of their training, spend time teaching, which also serves to broaden their interaction with the university as a whole. As they progress through the program, their status as students begins to gradually morph into that of colleagues as they begin to take on ever greater roles in the on-going research of their particular group, a change in status that often brings about a concomitant change in their social interactions.

Jobs

By the time graduate students are getting close to finishing and defending their dissertations, they have a firm idea of where they want to proceed, be it into academe, private industry, or government service. For those who choose academe, applying for and receiving a post-doctoral position is *sine qau non* for any academic career. The department's success rate in this regard has been remarkable by any measure, with the great majority of its post-doc applicants receiving a position after graduation. Graduates have also gone on to contribute to the fields of industry and commerce in positions that deal with systems engineering, financial analysis, national laboratories (e.g. Los Alamos National Laboratory, the Jet Propulsion Laboratory,) cancer research, software engineering, communications technology, and the military.

It is difficult to sum up the experience for the many different physics and astronomy graduate students here at UCLA simply because they themselves are such a diverse group, coming from all parts of the country and the world in pursuit of a wide array of scholarly endeavors within their disciplines. The one thing that does seem to characterize the experience of the department's graduate students is the intellectual and scholarly partnership that exists between each graduate student and his or her faculty mentors. The rigors of the program notwithstanding, most graduate students manage to thrive in an atmosphere of intellectual and scholarly growth within an academic setting that both fosters and directs intellectual curiosity and scholarly dialog. It is this commonality of focus that, perhaps more than any other single factor, is responsible for the continued high level of intellectual and scholarly achievement sought by the department and characteristic of its graduates.

Grad students getting together at Madison's, a local spot in Westwood Village

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Recognition opportunities in the New Physics & Astronomy Building

Building .....$15 million

Main auditorium.....$2.5 million

Roof terrace and conference suite.....$1.0 million

Lecture auditorum.....$750,000

50-seat classroom.....$250,000

Chair's suite.....$100,000

40-seat classroom (1st floor) $100,000

Graduate student study area.....$100,000

43-seat classroom (2nd floor).....$50,000

Renovations to the Leonard Lounge

Thanks to the time and effort of alum Dusan Petrac (Ph.D. 1971), the Leonard Student and Faculty Lounge campaign has successfully raised over $15,000. The old carpet was removed and a very durable floor was recently installed. The old kitchen was dismantled and replaced with a new kitchen sink and cabinet. Shown here is the new flooring. New furniture and two new computers, including a projection screen monitor, will be added.

John Dawson Award for Excellence in Plasma Physics

The American Physical Society (APS), along with UCLA and the Dawson family, have completed plans to establish an award honoring the life and the memory of physicist Dr. John Dawson, UCLA physicist and APS Fellow. This collaboration will build upon an APS award currently known as the Excellence in Plasma Physics Award, increase recognition of this award in the physics community, and endow it in perpetuity. APS will rename the award, calling it the John Dawson Award for Excellence in Plasma Physics, The recipient of this prestigious award will be invited to UCLA to present his or her research to an audience of physicists, scientists and lay people.

PAAL Outstanding Graduate Student Award

Seth Hornstein

Hanching Chu Czarnecka

PAAL 2003 Annual Summer Dinner Lecture

David Saltzberg of UCLA Department of Physics & Astronomy was the guest lecturer at the annual summer dinner on July 19, 2003. Professor Saltzberg's lecture was on "Neutrino Astronomy." Half of the Nobel Prize for 2003 was given for first observations of neutrinos from astrophysical sources. These discoveries were made by observatories developing innovative and difficult techniques. This has led to radical changes in physicists' understanding of the elemental properties of the neutrinos themselves, including the discovery that neutrinos have mass. Professor Saltzberg talked about the current work at UCLA, extending neutrino astronomy to extremely high energies where neutrinos rather than photons may be our best astronomical tool.

Career Day 2004

Every winter quarter, PAAL sponsors an event that brings alums and friends of the university to campus 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. Career Day 2004 took place at the UCLA Career Center on March 3, 2004, and included panelists from Boeing, Northrop Grumman, US Navy, Raytheon, Universal Pictures, JPL, and others. Attendance at this event has increased in numbers every year and has become very popular with the students.

The First PAAL Alumni Award Dinner & Lecture 2003

The PAAL Alumni award has been created to recognize important contributions by UCLA alumni to physics and astronomy, as well as the welfare and economic development of our country. The first award was given on November 1, 2003, to Bruce Winstein (B.Sc., 1965 UCLA). The dinner and lecture, held at the James West Alumni Center, was attended by over 65 alums and friends of the department.

Professor Winstein is currently the Samuel K. Allison Distinguished Service Professor in the Department of Physics at the University of Chicago. Previously, his research focused on experiments in elementary particle physics. He led the KTeV effort at Fermilab, which established for the first time a new form of matter/anti-matter asymmetry. He has authored 90 scientific publications. Professor Winstein has served on a variety of panels, advising U.S. Laboratories, the National Science Foundation, and the Department of Energy. He was elected to the National Academy of Sciences in 1995. Upon taking a Guggenheim Fellowship at Princeton he became a cosmologist. He directs Chicago's new NSF Center for Cosmological Physics, and continues to collaborate with Princeton, studying the fine-scale polarization of the cosmic microwave background radiation.

From left: Claudio Pellegrini, Andrea Johnson and Bruce Winstein

Research Highlights

Robert Cousins has been appointed deputy manager of the U.S. Compact Muon Solenoid (CMS) Research Program at the CERN laboratory. This is the program's highest-ranking position in line management to be held by a university-based physicist. The program is funded by the National Science Foundation and the U.S. Department of Energy. Professor Cousins works closely with the program manager at Fermilab to oversee the use of funds distributed to the 38 universities that constitute U.S. CMS..

Steven Cowley of UCLA and Bill Dorland of the University of Maryland have been named directors of the Center for Multiscale Plasma Dynamics. The Department of Energy funding for the UCLA/University of Maryland Fusion Science Center will total $6.4 million over five years. This center will bring together scientists with expertise in applied mathematics, theoretical and computational plasma physics, and basic and performance-dominated plasma experiments. The researchers will study the interaction of microscale and macroscale dynamics in key plasma physics problems. The center for fusion science will be focused on plasma physics problems for which the traditional separation of the dynamics into microscale and macroscale processes breaks down. Foremost among these problems are the sawtooth crash, the growth of neoclassical magnetic islands, and the formation and collapse of transport barriers. Each involves large scale flows and magnetic fields tightly coupled to the small scale kinetic dynamics of turbulence and particle acceleration. They are fundamental physics problems, and at the same time, issues of great practical importance to future fusion devices, such as the International Thermonuclear Experimental Reactor ITER. The center's physics program includes: basic experiments, participation in fusion performance related experiments, theory, and the development of new multi-scale computational techniques. The center also runs an extensive education program of courses, seminars and an annual winter school. The center's scientific program at UCLA will be lead by **Troy Carter, Steven Cowley, Jean-Noel Lebeouf, Tony Peebles** and **Walter Gekelman.** Details of the center's program and activities can be found at: *http://cmpd.umd.edu*.

Andrea Ghez

focus on excellence

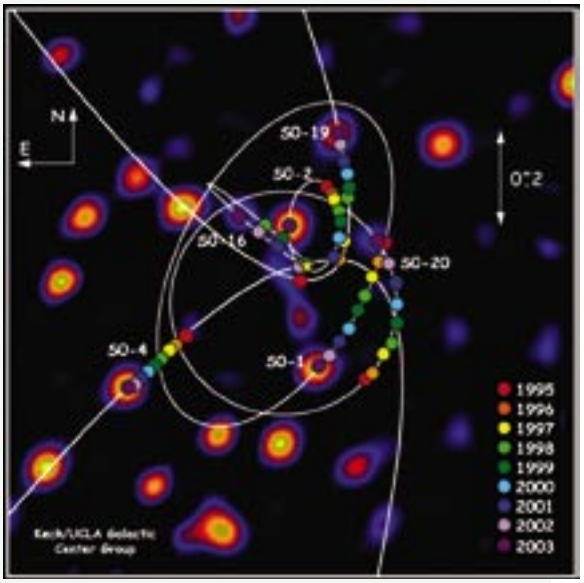
From left: Academic Senate Chair Clifford Brunk, **Andrea Ghez** (holding a commemorative certificate as the 95th Faculty Research Lecturer,) and Chancellor Albert Carnesale.

Andrea Ghez received her BS in Physics at Massachusetts Institute of Technology in 1987 and her Ph.D. in physics from the California Institute of Technology in 1992.
Professor Ghez joined the physics and astronomy faculty in 1994. Her recruitment was done jointly by physics and astronomy in recognition of the impending merger of the two departments. Roberto Peccei, then physics chair, and Mark Morris collaborated on the hire with support from infrared astronomers.

"Andrea has been a marvelous colleague in every respect," says Morris, "always focusing on what is best for students and the department, while unceasingly advancing her spectacular research agenda. A project that crystallized around Andrea and her expertise (speckle interferometry) is still going strong. New techniques and instruments have been developed and important, highly visible results obtained every season. This work involves students, post-docs and faculty, and is one of the unifying forces within the Astronomy Division," claims Morris.

Over the years, Andrea Ghez has won many awards, but in this academic year (2003-2004), she has been the recipient of five very prestigious honors. In October 2003 Andrea Ghez was the 95th Faculty Research Lecturer, UCLA's premier way to honor a member of the faculty and celebrate scholarly excellence within the campus community. In her lecture she discussed "Unveiling a Black Hole at the Center of the Milky Way." The lecture can be seen at *http://webcast.ucsd.edu:8080/ramgen/UCSD_TV/8807.rm*

".....we staged a real coup, attracting such a leader among her generation of astrophysicists," says Mark Morris



The central 1.2 X 1.2 arcseconds of our Galaxy. In the background, an image of the stars taken in 2003 is displayed and in the foreground, colored dots show the positions of some of these stars over almost a decade of time (multiple measurements are taken every year, but only the annual averages are shown here for clarity). Also plotted are the best-fitting simultaneous orbital solutions. These orbits, and a simple application of Kepler's Laws, provide the best evidence yet for a supermassive black hole, which has a mass of 4 million times the mass of the Sun.

On April 20, 2004, Andrea Ghez was elected to the National Academy of Science in recognition of distinguished and continuing achievements in original research. Election to membership in the Academy is considered one of the highest honors that can be accorded a U.S. scientist or engineer. Andrea is the second youngest scientist ever awarded this honor. The National Academy of Science is a private organization of scientists and engineers dedicated to the furtherance of science and its use for the general welfare. It was established in 1863 by a congressional act of incorporation, signed by Abraham Lincoln, which calls on the Academy to act as an official adviser to the federal government, upon request, in any matter of science or technology.

On April 30, 2004, the American Academy of Arts and Science, the nation's oldest and most illustrious learned society, honored Andrea Ghez as one of the 202 men and women elected to the Academy. Election to this Academy has always been one of the highest honors in the United States.

Andrea Ghez was elected a Co-Winner of the 2004 Sackler Prize for her pioneering, high-resolution infrared observations that provide evidence for, and establish the mass of, the supermassive blackhole in the center of the Galaxy. The Raymond and Beverly Sackler Prize in the Physical Sciences was established through the generosity of Dr. Raymond and Mrs. Beverly Sackler and is administered by Tel-Aviv University (TAU).

Lastly, Andrea Ghez has been awarded the 2004 Gold Shield Faculty Prize for Academic Excellence. The prize, presented to a UCLA faculty member every second year, recognizes extraordinary accomplishment in research, outstanding teaching and distinguished university service. The Gold Shield Prize includes a $30,000 award for unrestricted research funding. It is presented by Gold Shield Alumnae of UCLA, an honorary service and philanthropic organization for women graduates of UCLA whose members are chosen based on their university service and outstanding professional and community achievements.

Galactic Astronomy

Eric Becklin's primary research over the last year has been the search for High Mass Planets and Brown Dwarfs in various astronomical environments. To do this work he and his student and collaborators have used the Lick 3-meter telescope and the Keck 10 meter telescope using various infrared and optical instrumentation. Professor Becklin has continued his work on the nature of the Center of our Galaxy 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. Efforts this past year include testing of the telescope in the aircraft and planning for the first flight of the modified aircraft this coming winter. The majority of time this year has involved the planning for operations of the observatory, which will begin early 2006.

Michael Jura's research has shown that Kuiper belt objects in orbit around red giants would be sublimated as the star becomes more luminous and thus produce an infrared excess. The Kuiper Belt is the system of objects the size of Pluto, or smaller, that are typically 40 Astronomical Units from the Sun. Current data show that other stars typically have upper limits to the total masses in their Kuiper belts of about 0.1 of the mass of the Earth–about the same as the mass of the Kuiper belt in our own Solar System. Research shows that it may be possible to detect planets with evaporating oceans by the ultraviolet absorption lines that the gaseous outflow produces in the spectrum of the host star. Since water is essential to life as we know it, a plan is being developed to search for this signature of planets where life may exist.

Ian McLean and colleagues began a major survey of Brown Dwarfs, following the delivery of the UCLA-built NIRSPEC infrared spectrometer to the giant Keck telescopes in April 1999. Brown Dwarfs have about the same diameter as Jupiter, but range in mass 13-80 times that of Jupiter; no nuclear reactions occur at all below 13 Jupiter masses. In October 2003, Professor McLean and his colleagues (Mark McGovern, Adam Burgasser, Davy Kirkpatrick, Lisa Prato and Sungsoo Kim) announced the completion of the NIRSPEC Brown Dwarf Spectroscopic Survey and provided an on-line archive with over 50 of the highest quality infrared spectra of Brown Dwarfs ever obtained. A UCLA press release written by Stuart Wolpert (September. 3, 2003) claimed, "UCLA astronomers obtain molecular fingerprints for celestial Brown Dwarfs – the missing link between stars and planets." [See *http://www.astro.ucla.edu/~mclean/BDSSarchive* for more details.] During the past year, the UCLA Infrared Lab led by Professor McLean also completed its fifth field trial of FLITECAM, the first light camera for the Stratospheric Observatory for Infrared Astronomy (for which UCLA's **Eric E. Becklin** is the Science Director). From these runs, **Amy K. Mainzer** got her Ph.D.

Professor McLean acted as Keck Observatory spokesperson for the third time at the international conference on Astronomical Telescopes & Instrumentation, held every two years (June 2004).

Mark Morris continues his work on the Galactic Center, employing several different approaches. Using the Chandra X-ray observatory (in collaboration with Fred Baganoff, Mike Muno, Sangwook Park and others), he has studied the diffuse X-ray emission from the central 40 parsecs of the Galaxy, and has determined that it is unlikely to be due to a sea of unresolved point sources. An investigation of the implied galactic wind is now in progress with Mike Muno and Cheng-Chin Wu. The X-ray source associated with the central supermassive black hole of our Galaxy continues to undergo X-ray flares about once a day, and this year for the first time, a simultaneous flare was observed both with Chandra in X-rays and with the European Very Large Telescope in the infrared. Attempts to find and measure other simultaneous flares are underway because they can provide strong evidence for the nature of the flaring medium near the event horizon of the Black Hole.

On January 25, 2004 The Board of Directors of the W.M. Keck Observatory appointed **Ian McLean** co-chair of the Science Steering Committee. This is the first time this appointment has come to UCLA.

Credit: NASA/JPL-Caltech

Mike Jura and **Edward L. Wright** have been working with data from the Spitzer Space Telescope. The image above shows the Space Infrared Telescope Facility launched from Cape Canaveral Air Force Station in Florida on Monday, August 25, 2003, at 1:35 a.m. EDT.

Brad Hansen was awarded an Alfred P. Sloan Fellowship on February 18, 2004, for the academic year 2004-05. The awards are intended to enhance the careers of the very best young faculty members in specified fields of science. The fellowships are awarded annually in seven fields.

This photo shows the OSIRIS spectrograph with its vacuum chamber lifted to reveal the optics and electronics. The instrument weighs close to two tons and all of the optical components (more than 500 pounds worth) are cooled to 70K (-334F) to reduce the infrared background.

Mark Morris, with SOFIA postdoc **Ralph Shuping** and John Bally (University of Colorado), reported the highest resolution view of the star formation factory in Orion ever obtained in the mid-infrared. With near diffraction-limited observations, they were able to take advantage of the 10-m size of the Keck Telescope to observe details that are important for sorting out the complexity of this cluster of recently-formed, massive protostars. This same group, plus Nathan Smith (also Colorado) and Tom Hayward (National Optical Astronomy Observatory,) has completed a study with the Gemini South Telescope of an obscured but very active region just to the south of the most visually prominent region of star formation in Orion.

Mark Morris has continued his long-term collaboration with Raghvendra Sahai (JPL) on mass loss from stars undergoing the dramatic transition from red giant stars (AGB stars) to planetary nebulae. With data acquired from the Hubble Space Telescope, this past year has been very productive.

Edward L. Wright is working on cosmology and infrared astronomy from space. The Wilkinson Microwave Anisotropy Probe (WMAP) has now finished three years of data collection. The Spitzer Space Telescope was launched in 2003, and the Wide-Field Infrared Survey Explorer (WISE), a space mission to map the entire sky in the mid-infrared, is finishing an extended Phase A study.

Extra-Galactic Astronomy

Using the Hubble Space Telescope, **Michael Rich** completed major programs involving the study of M31. Deep HST imaging in 16 fields covering the halo and disk of M31 reveal a remarkably metal-rich halo, some 10 times as metal-rich as that of the Milky Way, with the metal-rich stars nearly having the Sun's iron abundance. The longest exposure yet obtained on the Hubble space telescope, (also in the stellar halo of M31) gives surprising results. The image, obtained with the new Advanced Camera for Surveys over 100 orbits, shows that the outer halo of M31 has a large fraction of stars in the age range of 6-11 Gyr and 1/3 Solar metallicity. The presence of such a large fraction of intermediate-age stars contradicts the standard model that halo populations are composed only of the first generation of stars to form in a galaxy. In the case of M31, the large numbers of metal-rich stars may have originated in a now disrupted massive companion.

Michael Rich and **Mark Morris**, in collaboration with former UCLA Ph.D. student Don Figer, analyzed deep Hubble infrared images of the stellar population near the Galactic Center, finding evidence that the nucleus of the Milky Way has been growing in mass steadily since its formation. The history of the Milky Way nucleus is interesting, since a massive black hole (the subject of studies by Andrea Ghez) has been demonstrated to be present in the nucleus. The Hubble/NICMOS images were the first ever to show old helium burning stars only 10 pc from the Galactic nucleus, indicating that stars older than a few Gyr are definitely present.

Samir Salim, **Michael Rich,** and **Brad Hansen** used the Keck Telescope and the Nickel 40-inch telescope to settle a long-standing controversy that white dwarf stars may be at least partially responsible for the mysterious dark matter in the Milky Way. Salim, Rich, and Hansen obtained radial velocities for the very faint stars at Keck, and new CCD photometry at the Nickel Telescope. With newly measured photometric distances and velocities, the team showed that the number of white dwarfs was consistent with that expected for the normal Galactic stellar halo.

UCLA astronomer **Michael Rich** is on the Galaxy Evolution Explorer (Galex) Science team; Samir Salim (UCLA postdoc) is also a collaborator. Galex was launched successfully in April 2003, and began regular science operations in July 2003. The 50cm satellite images a 1.2 degree circular field in two wavelengths of ultraviolet light (120 -

180nm and 180-2600nm), and is capable of obtaining low resolution slitless spectra over the entire field. Major findings include the discovery of local counterparts to the very luminous, high redshift "lyman break" galaxies. Galex has discovered galaxies at z<0.2 which give >10^10 Lsun in UV radiation and look very much like fossil survivors of a population of extreme starburst galaxies in the local universe. Galex has also discovered star formation in the distant outer disks of galaxies, and in tidal tails of interacting galaxies.

James Larkin is the principle investigator for a $4.2 million spectrograph being built for the Keck Telescope. Dubbed OSIRIS (OH-Suppressing Infra-Red Imaging Spec-trograph,) this instrument is expected to become the most sensitive infrared spectrograph ever built and will open up several new areas of research. In particular, it will have roughly 10 times the angular resolution of most existing spectrographs and is ideal for studying the formation and evolution of galaxies, the interaction of supermassive black holes with their host galaxies, and the study of very low mass companions to nearby stars. The primary design and construction has occurred within the UCLA Infrared Detector Laboratory in Knudsen Hall. After four years of development, the spectrograph is nearing completion and should see "first light" in December 2004. In preparation for its use, Professor Larkin is also leading an observing program to find and characterize galaxies in the early universe at very high angular resolution that will be "dissected" by the OSIRIS spectrograph.

Ian McLean is shown here along side FLITECAM (blue cylinder), the first-light, near-infrared camera for NASA's Stratospheric Observatory for Infrared Astronomy (SOFIA). FLITECAM will be delivered to the NASA Ames Research center in 2005 for integration into SOFIA.

Astroparticle Physics

David Cline's group continue its effort to detect dark matter elementary particles with ZEPLIN II and our proposed ZEPLIN IV. They have submitted letters of interest to the Sudbury Neutrino Observatory Laboratory for the latter and defended the program at the Scientific Assessment Group on Experimental Non-Accelerator Physics review in April 2004. A second major effort is to detect the decay of the proton to probe physics at the energy scale of the very early universe: the Grand Unification theory. Professor Cline's group is part of the ICARUS Liquid Argon Team at the Italian Gran Sasso lab. A 70,000 ton detector called LANNDD for the USA (the new NSF underground lab) has been proposed. This detector can search for p-decay to the ultimate limit on earth. A third area of investigation is to show that a supernova II explosion could break chiral symmetry on the ISM pre-solar clouds with hydrocarbons, possibly leading to the molecular effects seen in DNA, RNA and proteins in light.

Rene Ong's research is focused on very high energy astrophysics using gamma rays and cosmic rays. Ground-based gamma-ray telescopes based on the atmospheric Cherenkov technique are used. Professor Ong is the principal investigator of the STACEE telescope at Sandia National Labs near Albuquerque, New Mexico. During the last year, Professor Ong and colleagues carried out extensive observations of a number of galactic and extragalactic sources. Researchers at STACEE detected rapid flares of gamma rays from the active galaxy Markarian 421, with peak rates exceeding a thousand gamma rays per hour. They are in the process of measuring the energy spectra of the sources that have been observed in order to constrain the diffuse cosmic infrared background.

A group led by **Professors Ong** and **Vladimir Vassiliev** is carrying out gamma-ray observations with the Whipple Telescope on Mt. Hopkins, Arizona. A significant result this year was the detection of TeV gamma rays from the galactic center region. Professors Ong and Vassiliev are also collaborating in a major new gamma-ray telescope project called VERITAS which will be located on Kitt Peak in southern Arizona. . VERITAS was approved October 2003, and the construction of a four-telescope array should be completed in 2006. The first telescope will start operations in early 2005. Professors Ong and Vassiliev are developing trigger electronics, online software, and simulation software for the project.

David Saltzberg's group continued its collaboration with NASA and the University of Hawaii looking for ultra-high energy neutrinos striking the moon. After three years of observation, no events were observed and limits on the intensity of ultra-high energy neutrinos will be publishied in Physical Review Letters. A popular article by Oliver Morton describing this experiment for American Scholar won the David Schramm prize for science writing.

In November 2003, **W. Gilbert Clark** was elected Chair of the Users Committee of the National High Magnetic Field Laboratory for the year 2004.

Chetan Nayak along with Professor Sankar Das Sarma of the University of Maryland and Professor Alexei Kitaev of Caltech, have received a grant from the Army Research Office supporting further study on their approach to quantum computation.

Postdoctoral Fellow **Peter Armitage** is one of the 33 selected researchers across all science disciplines to receive this year's National Science Foundation International Research Fellows Award. Dr. Armitage will conduct research at the Université de Genève concerning the nanoscale electrodynamic response of various complex solid-state quantum systems.

Nuclear Physics

Huan Z. Huang, Charles Whitten and **George Igo** (The UCLA group) have been a leading university group in the STAR collaboration at Brookhaven National Laboratory (BNL) Relativistic Heavy Ion Collider (RHIC). The heavy ion research program has made great strides towards the discovery of the Quark-Gluon Plasma at RHIC. Experimental measurements from gold+gold and deuteron+gold collisions at RHIC have shown that a matter with unprecedented high energy density and temperature has been created. Furthermore, the produced matter exhibits dynamically features consistent with expectations from a QGP formation. The UCLA group has taken a high statistical data sample of Au+Au collisions in 2004. Their research program focuses on charm and strange quark probes of the dense matter created at RHIC through measurements of nuclear modification factors and collective flow dynamics. In addition, they have a vigorous program to search for exotic particles at RHIC. The RHIC spin physics program using polarized p+p collisions has also made significant progresses. Most importantly RHIC has achieved much improved beam polarization and luminosity during the machine development in 2004.

Condensed Matter

Stuart Brown and his research group (graduate students **Fan Zhang, Jun Shinagawa;** and undergraduates **Colin Parker** and **Ted Tao**) have been exploring competing instabilities of correlated electron systems using solid state Nuclear Magnetic Resonance (NMR). In contrast, their high-pressure NMR experiments probe locally the magnetic environment of the 29Si nucleus in MnSi. They also provide evidence for a new phase with weak static magnetism, distinct from what is seen at lower pressure. Of interest to Professor Brown and his group is the phenomenon of weak itinerant (metallic) ferromagnetism (FM). Materials that fall into this class include MnSi, ZrZn2 and Au4V. These systems, in contrast to the elemental ferromagnets Fe and Ni, undergo magnetic transitions at a relatively low temperature and the strength of the ordered moments is very small. The transition to the FM state is suppressed by modest pressure, beyond which the ground state at greater pressures is expected to be an ordinary metal.

Robijn Bruinsma and **Joseph Rudnick** are currently carrying out research on topics in biological physics, one of the most rapidly growing areas in the discipline. Joseph Rudnick applies techniques borrowed from quantum mechanics and statistical mechanics to the investigation of the mechanical and overall conformational properties of linear polyelectrolytes, exemplified by "naked" DNA. Professor Rudnick is also pursuing a program of study into aspects of the thermal denaturation, or melting, of DNA. Robijn Bruinsma and Joseph Rudnick have utilized techniques originating in statistical mechanics, along with results of elasticity theory and aqueous electrostatics, to gain insight into the assembly of viruses from their constituent protein and genomic components. This theoretical work is being carried out in close collaboration with an experimental group in the UCLA Department of Chemistry and Biochemistry. Additionally, Robijn Bruinsma studies the theory of self-assembly of biopolymers, such as the muscle protein Actin, as well as cell adhesion and recognition.

Quantum mechanics forms the theoretical basis of many novel materials that continue to be discovered today, such as high-Tc superconductors, ruthenates, manganates, fullerenes, and heavy electron materials. **Sudip Chakravarty's** research during the past year has involved the theory of high temperature cuprate superconductors and quantum phase transitions in the presence of dissipation. Professor Chakravarty is fascinated by the idea of ordered phases that are hidden, but surreptitiously control the general properties of matter. One of the papers published in Nature "An explanation for a universality of transition temperatures in families of copper oxide superconductors," Nature 428, 53-55 (2004). was highlighted in a News and Views article in the same issue

W. Gilbert Clark has recently carried out Nuclear Magnetic Resonance (NMR) measurements on the two-dimensional organic conductor lambda-$(BETS)_2FeCl_4$. The lambda conductor has an unusual phase diagram as a function of temperature and magnetic field that includes a paramagnetic metal (PM) phase, an antiferromagnetic insulating (AFI) phase, and a

field-induced super-conducting phase. The experimental challenge of obtaining a viable NMR signal from the unusually small sample with a mass of only about 3 micrograms (approximately $2x10^{16}$ protons) has been overcome by developing extremely small NMR coils. Another experimental advance has been to measure the proton spin-lattice relaxation rate over the temperature range 2-300 K in the electrically conducting polymer doped poly(3-methyl thiophene). These measurements should help to establish what are the dominant mechanisms of electron transport in this and similar materials.

Hong-Wen Jiang, along with graduate student **Ming Xiao** and colleagues Ivar Martin (a theoretical physicist from Los Alamos National Laboratory) and Eli Yablonovitch, (UCLA professor of electrical engineering and director of UCLA's Center for Nanoscience Innovation for Defense) worked on the electrical detection of the magnetic resonance spin-flips of a single electron paramagnetic spin centre, formed by a defect in the gate oxide of a standard silicon field transistor. The experiment has a significant impact on the physical implementation of quantum information processing. The ability to manipulate and monitor a single electron spin using electron-spin resonance is a long-sought goal. Read-out of single spin states has been achieved using optical techniques, but electrical read-out of single spins has so far remained elusive.

Thomas Mason has formed a research group that is performing experiments in the area of soft materials. They are using extreme mechanical shear to disperse very small droplets of oil into water, thereby creating nanoscale emulsions. These nanoemulsions may offer potential advantages in applications ranging from microfluidics to drug delivery. Professor Mason's group has also begun creating the first dispersions of polymeric particles that have custom designed shapes, using photolithography. They have made dispersions of monodisperse square crosses and square donuts in water, and are studying the phase behavior of these particles as a function of concentration to better understand the behavior of liquid crystal molecules. The group can manipulate and control individual particles using laser tweezers, a method of trapping a microparticle in a laser beam focused by the objective lens of an optical microscope. These particles and the laser tweezers are used as probes to investigate the stress-strain relationships of complex fluids, such as polymer solutions (e.g. "jelly"), around the particles. This is a new approach in the emerging field of microrheology.

Chetan Nayak continues his collaboration with Dr. Michael Freedman of Microsoft Research on quantum computation. They have been studying the properties of matter when it condenses in a topological phase. It is extremely robust against local perturbations, but sensitive to the topology of the system. This makes such phases ideal for quantum computation, where one would like a system which is robust against errors introduced by the environment (which is a local probe) and yet easily manipulable so that computations can be performed. The ultimate goal of the project is to find or engineer a material which supports such a phase and to design a quantum computer using it. Professor Nayak and Dr. Freedman, along with Dr. Kirill Shtengel, constructed a soluble microscopic model of an electron system in a topological phase. In studying the stability of these phases, they have discovered a line of critical points with continuously varying exponents and other exotic properties. In conjunction with **Sudip Chakravarty** and post-doctoral collaborators. Professor Nayak has continued study of the d-density wave (DDW) theory of the pseudogap state of the high-temperature superconductors. Analyses have recently been completed of the expected scanning tunneling microscopy (STM) spectra associated with his group's theory.

The acoustics lab group led by **Seth Putterman** has reported observation of picosecond flashes of light emitted by a bubble of xenon pulsating at one million cycles per second. The spectrum of light matches the spectrum of a one-million-degree plasma. To see if temperature is scaling with acoustic frequency, extreme ultrasound devices operating at 30MegaHertz are being developed for the next round of experiments on sonoluminescence. Professor Putterman claims that another energy-focusing phenomena of interest is exhibited by ferroelectric crystals. When heated by tens of degrees above room temperature, these crystals emit a stream of electrons with relativistic energies. When stopped by a target, x-rays are gener-

Sudip Chakravarty assisted in organizing an Aspen Summer Workshop in 2004 on "Coherence and Dissipation in Quantum Systems". He is also the co-organizer of the Aspen Winter Conference (January 9 -15, 2005) on "Condensed Matter Physics: High Temperature Superconductivity."

Rubin Braunstein and collaborators are using various techniques in a study to develop blood biomarkers for the screening for pancreatic and other cancers. This pursuit involves a diverse group consisting of individuals in the Physics Department, the Department of radiation Oncology and Radiological Sciences, the MacDonald Medical Research Laboratories at UCLA, and support from the Veterans Administration Greater Los Angeles Healthcare System.

From left, Barakat Alavi, Amos Norman, Rubin Braunstein, James Roseboro and Keisuke Iwamoto

Nina Byers was elected Chair of the Forum on History of Physics of the American Physical Society and serves in this capacity in 2004-2005

The SLAC team, clockwise from top: **Paul Schoessow** (Argonne), Dieter Walz(SLAC), **Dawn Williams** (with "mascot"), **David Saltzberg** (UCLA), **Peter Gorham** (JPL)

Graduate student **Dawn Williams** received her Ph.D. for Astronomy in Spring 2004 for observation of the Askaryan effect and applications to searches for ultra-high energy neutrinos.

From left: **Ben Nefkens, John Price**, and **Sasha Starostin** standing behind the top half of the Crystal Ball detector

ated with energies that can exceed 100KeV. Devices with these characteristics have been built, and Professor Putterman and the acoustics lab group are in the process of scaling up the current and downscaling the size so as to make it potentially useful for biomedical applications.

Gary Williams and graduate student **Han-Ching Chu Czarnecka** have measured the superfluid density of very thin helium films adsorbed in a nanoporous ceramic, which has long cylindrical pores with diameters of 4 nanometers. As the thickness of the superfluid film was reduced to less than one atomic layer, they observed a crossover in the effective dimensionality of the superfluid phase transition, from two dimensions to one dimension. This is in good agreement with theoretical models of the transition in cylindrical channels. **Joseph Rudnick** has been doing work on Casimir forces in quantum fluids, an effort that complements the research of Professor Gary Williams

The biophysics group led by **Giovanni Zocchi** studies conformational changes in biomolecules. One example is bubbles in DNA. Melting of the DNA double helix into separate strands proceeds through local opening of single-stranded regions ("bubbles"). Prof. Zocchi and his team have developed a technique to trap such intermediate states and measure directly the bubble length [Phys. Rev. Lett. 91, 148101 (2003)]. A second example is the dynamics of protein - DNA interactions. In this work, a mechanical nano-device is used to observe in real time a single protein bind to and fall off a short piece of DNA. The method represents a new paradigm for analytical assays, where the target molecule (the protein) is detected through the change in conformation of a probe molecule (the DNA) to which it binds. Likely applications include high throughput screening assays to identify specific protein-binding sequences in the DNA. This device allows us to study the dynamics of fundamental processes such as DNA looping, which is involved in the regulation of eukaryotic genes.

Experimental Elementary Particles

The CDF (Collider Detector at Fermilab) group, led by **Jay Hauser, David Saltzberg,** and **Rainer Wallny**, has been taking and analyzing data from the high-energy collisions of protons against antiprotons. The tremendous energy of these particles is converted into very massive particles, such as the top quark, according to Einstein's equation $E=mc^2$. All of the UCLA-built portions of CDF have been working well. Rainer Wallny took a leave of absence from UCLA in order to be the project leader of the operations group for the silicon sub-detector of CDF. This system is one of the largest devices of its kind, and is crucial to the detection of top and bottom quarks. Professor Saltzberg authored two papers with graduate students Matt Worcester and David Goldstein pertaining to two-electron and two-muon events. Professor Saltzberg has produced a new "uber-prescaling" method for maximizing the number of bottom quark events collected by the experiment during data-taking. Postdoctoral **Florencia Canelli** has improved the statistical methods used to measure the top quark mass and together with Rainer Wallny is exploring their application to searches for single top quark production. Professor Hauser is working with two graduate students on analyses that search for supersymmetric particles: **Brian Mohr** is applying Canelli's methods to search for supersymmetric partners of the top quark (known as "stop" quarks!), and **Alon Attal** is searching for four-electron and other four-lepton events as a signal for a theory known as "R-parity violating Supersymmetry." Professor Saltzberg is searching for two-muon events from the decay of the bottom-strange meson particle that could be greatly enhanced by Supersymmetry, with graduate student **Nick Wisniewski** and postdoctoral researcher **Charles Plager.** Associate Research Physicist Mike Lindgren, took a position at Fermilab as project manager of the large experiment called BTeV.

Katsushi Arisaka, David Cline, Robert Cousins, Jay Hauser, and **Peter Schlein** are collaborating on building the CMS (Compact Muon Solenoid) detector at the CERN laboratory near Geneva, Switzerland. This very large, long-term scientific project is being built to discover the centerpiece of the Standard Model of fundamental forces and particles, namely the Higgs boson. The CMS experiment looks at the debris from ultra-high energy collisions of proton beams at seven times the energy available to the current CDF experiment previously mentioned. The apparatus will be ready in 2007,

and excitement is increasing dramatically as they come closer to taking data to look for the Higgs and other hypothetical particles. A major part of the UCLA group has concentrated its work on the huge endcap muon particle detection system, which has come together faster than any other CMS sub-detector. The UCLA-assembled detector chambers by Katsushi Arisaka and Mikhael Ignatenko have been completed and are at CERN, being installed by David Cline's group. Tests using cosmic ray muons are very successful. Jay Hauser and postdoctoral scholars **Martin von der Mey** and **Yangheng Zheng** supervised an army of UCLA undergraduate students who produced and tested on-detector electronics that convert the muon signals to useable form. Robert Cousins and postdoctoral researcher **Slava Valuev** and graduate student **Jason Mumford** developed software that improves the momentum measurement for muon particles and extends the ability of CMS to discover the hypothetical "Z-prime" particle. Research physicist **Samim Erhan**, in Peter Schlein's group, works on building the challenging CMS Data-Acquisition system, which has to cope with a collision rate about 100 times larger than the CDF experiment; together they study the potential for Higgs production in special interesting subsets of CMS interactions.

The UCLA Hadronization Group headed by **Charles Buchanan,** along with collaborators **Shahriar Abachi, Andrew Chien, Brandon Hartfield**, has made significant progress in the last year in understanding the processes by which hadrons (protons, neutrons, pions, kaons, etc) are formed from quarks and antiquarks. The group has recently made significant advances: 1) The meson description of the UCLA Model has been successfully extended to include mesons involving heavy quarks – that is, charmed or bottom quarks or antiquarks; 2) using data from the BaBar collaboration at Stanford, they are analyzing large samples of high quality data on baryon rates and distributions in order to begin to understand how baryons are formed. Two studies are maturing: a) an accurate set of data on the production rates and distributions of strange baryons such as lambda's, tsi's, omega-minus's in order to guide the extension of the UCLA Model into the baryon area; and b) a study of lambdaC-antilambdaC events is providing the first direct evidence that "popcorn" mesons are produced between the baryon and the antibaryon.

The Pierre-Auger Observatory is the largest facility for investigations aimed at elucidating possible new physics interactions both at the highest energy scale and the shortest distances. Its construction in the Southern Hemisphere is well underway in Argentina. UCLA is one of the leading institutions in this large international collaboration. The local participants are **Katsushi Arisaka**, **William Slater, Alexander Kusenko** and **Graciela Gelmini**, together with researchers **Tripathi, Semikoz** and five graduate students. The group took charge of assembling, testing and calibrating some 5000 photon detectors. Based on this work, systematic studies of the absolute energy and angular distribution of the first year of data have been performed

The goals of the experimental group led by **Bernard M.K. Nefkens** are the physics of broken symmetries and the structure of the baryons. Professor Nefkens and his group have recently begun a new photoproduction program at the Mainz Microtron (MAMI) in Germany with the Crystal Ball detector. Professor Nefkens is one of the two leaders of this international collaboration. Among the work planned at MAMI is a measurement of the magnetic moment of the Delta, an excited state of the proton; precision measurements of the mass of the eta meson and of various rare decay modes of the eta; and a study of the effect of the nuclear medium on matter. The group's other major project is the photoproduction 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." An aspect of this program that has particular interest is the possibility of seeing the elusive "pentaquark" particles that have recently been discovered. If these particles indeed exist, photoproduction may be the best way to search for them.

Theoretical Elementary Particles

John Cornwall continues in first-principle problems of quantum chromodynamics (QCD), the theory of how quarks are bound into familiar particles such as proton and neutrons. Professor Cornwall has shown in detail how protons, made of three quarks, are held

After recommendation by a fellowship committee the full *American Physical Society* council selects only one half of 1% of the total APS membership for fellowship in the society each year. This year three of the new fellows are:

Rene A Ong was chosen for his contribution to high energy particle astrophysics, in particular his contribution to very high energy gamma ray astronomy, where his research has spanned four decades of the electromagnetic spectrum.

Stuart E Brown was chosen for fundamental studies of low dimensional, highly correlated materials, especially using high pressure NMR, transport, and thermodynamic measurements; and for studies of the non-linear dynamics of charge-density waves.

Gary Williams was named a fellow for experimental and theoretical demonstrations for the role of quantized vorticity in superfluid phase transitions in two and three dimensions.

Nina Byers was a Visiting Scholar at Harvard University, where she completed compilation of a volume of essays written by forty distinguished authors, including Freeman Dyson, Abraham Pais,and Vera Rubin. A book, entitled "Out of the Shadows: Contributions of Twentieth Century Women to Physics," edited by Professor Byers and Professor Gary Williams, is to be published by Cambridge University Press. Professor Byers also began studying with Professor Abdelhamid Sabra the great work on optics by the ninth century arabic scholar Ibn al-Haytham

Zvi Bern was chairman of the organizing committee of the 2004 Collider Physics Workshop held at the Kavli Institute for Theoretical Physics at Santa Barbara, January 12 - April 2, 2004. This very successful workshop should continue to have an important impact on the field for years to come.

John Cornwall became Chairman of the Advanced Simulations and Computing Predictive Science Committee, which reviews some of the computing and simulations programs at Livermore and Los Alamos National Laboratories.

together by strings. Amazingly, this problem has been controversial and unresolved for 30 years. His work there has always had two plausible answers. He showed that only one of these answers actually holds for QCD. Professor Cornwall gave a specific relationship between the strings mentioned above and the areas of some surfaces that had the strings as boundaries; this relationship is crucial for QCD calculations and had not been fully understood before.

Eric D'Hoker and collaborator D.H. Phong at Columbia University explore superstring theory, and are building on their recent breakthrough in the understanding of perturbation theory. Over the past year, they have explored applications to the scattering amplitudes of superstrings, to the magnitude of the cosmological constant predicted in models with supersymmetry breaking, and to the mathematics of vector bundles on Riemann surfaces. In neutrino physics, Eric D'Hoker and collaborator Robert Shrock at CCNY Stony Brook are investigating the possible enhancement of neutrino dipole magnetic moments due to chiral anomalies and the implications of such enhancements on neutrino astrophysics.

Per Kraus has obtained results in a number of areas, ranging from supersymmetric gauge theories to classical general relativity. Professor Kraus, along with **Michael Gutperle,** have carried out a sensitive numerical test of the cosmic censorship conjecture, which roughly states that any singularities formed in the process of gravitational collapse will be hidden behind event horizons, and thus invisible to an external observer. They also found that the conjecture is upheld, contrary to some speculations in the literature. Professor Kraus and Iosif Bena discovered some new objects in string theory that may yield a microscopic description of black hole entropy. These are extended "supertubes," whose precise shape can encode the quantum state of the corresponding black hole.

Zvi Bern's two main areas of research have been in collider physics and in theoretical properties of gauge theories. In a Physical Review Letters, Zvi Bern, Lance Dixon (SLAC) and David Kosower (Saclay) proposed that it may be possible to solve maximally supersymmetric gauge theory. Professor Bern, along with UCLA postdocs **Iosif Bena** and **David Kosower,** found a way to rearrange the diagrammatic rules (proposed by Edward Witten and his collaborators) to make them overwhelmingly the most efficient way to calculate multi-particle scattering amplitudes in QCD and other effectively massless gauge theories. The rearrangement also sheds light on the link found by Witten to topological string theory. Professor Bern and colleagues performed a number of state-of-the-art computations. With the help of Academic Technology Services at UCLA, Zvi Bern and **Vladimir Vassiliev** set up a new beowulf cluster for use in theoretical higher energy and astroparticle calculations.

Observations show that most of the matter in the universe is not stars, planets, or gas, but the so called dark matter. Although dark matter cannot be seen, it creates a gravitational field whose effects are observable. **Alexander Kusenko** and collaborators have shown that two long-standing puzzles, dark matter and large pulsar velocities, may have a simultaneous solution in the existence of a singlet neutrino with mass 2-20 keV and a small mixing with the electron neutrino. This particle, a dark matter candidate, would be emitted anisotropically from a cooling neutron star born in a supernova explosion. The asymmetry would give the neutron star a kick consistent with the measured velocities as large as 1000 km/s. Graduate student **Lee Loveridge** has calculated the gravity waves that one expects to detect from a neutron star being accelerated by neutrinos in the event of a nearby supernova.

Plasma and Advanced Accelerators

Steven Cowley and colleagues are investigating dynamo action in protogalaxies, galaxies, and clusters of galaxies by dynamo processes. The study utilizes large computational resources to examine the various stages of magnetic field growth. The dynamo growth involves the interaction of physical processes at vastly differing scales – direct simulation of the whole problem is therefore impossible. The strategy is to address the problem on small and large scales separately. The growth and dynamics of small scale fields and

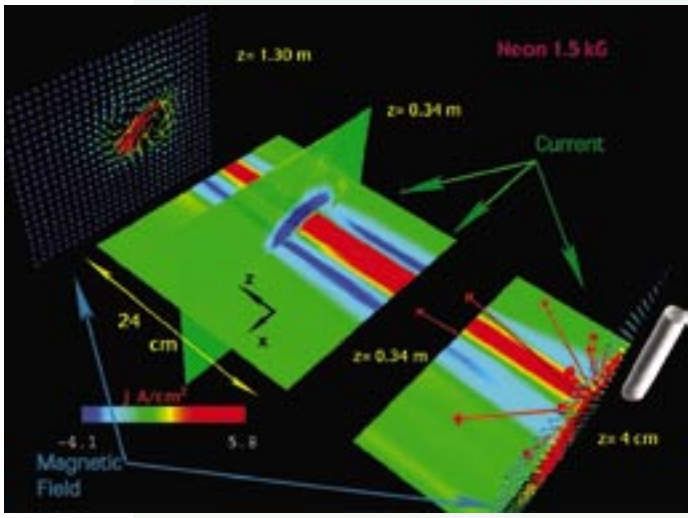
flows are being studied using homogeneous/isotropic simulations. Simulations of large scale flows and fields in discs using a lagrangian particle method are also underway. Ultimately theyhope to develop a model of the small scale field and flows to incorporate into simulations of the large scales. Professor Cowley and colleagues have developed, in a series of papers, a possible explanation for explosive events and nonlinear explosive ballooning. In this mechanism, a narrow finger of plasma erupts from inside the plasma, growing explosively and pushing aside other field lines. The instability spreads from a small region until it disturbs lines across a large section of plasma. The model predicts the observed features of some high /≤ disruptions and Edge Localized Modes in tokamaks. They have also investigated possible application of this mechanism to magnetospheric substorms and solar flares.

Walter Gekelman and colleagues **James Maggs, Steve Vincena, David Leneman** and **Patrick Pribyl** conducted laser-target experiments with a great deal of success. Experiments were performed at the Basic Plasma Science Facility (BaPSF) in the upgraded LAPD. The experiments involve the production of a dense plasma cloud by a laser striking a target material placed in a magnetized background plasma capable of supporting Alfvén waves. The experiments shed light on the physics of coronal mass ejections, artificial injections of material in the magnetosphere and ionosphere, and pellet injection fueling in fusion devices. Another class of experiments involved the heating of plasmas using high-power micro-waves. The initial results from these experiments indicate that electron heating leads to a rich variety of low frequency phenomena in the background plasma, including plasma flows and currents that generate Alfvén waves. Experiments involving extremely narrow current channels are underway. Remaining proposed experiments involve the generation of flows associated with density cavities and temperature filaments. When the LIF diagnostic is completely functional, they will use it to map the flow fields associated with these processes. They have also recently developed high current RF sources and used them to generate large amplitude shear Alfvén waves.

George Morales and **James Maggs**, as a result of an NSF-sponsored study, have discovered that it is possible to realize in the laboratory the reliable operation of an Alfvén wave maser in the shear-mode of polarization. This is a capability that has not been previously achieved and is only possible to pursue at this time because of the unique infrastructure available at the Basic Plasma Science Facility (BaPSF) jointly supported by NSF and DOE at UCLA. The research pursued by Maggs and Morales on this topic addresses the following issues: 1) Solidify the understanding of the mechanisms responsible for the operation of an Alfvén maser having shear-mode polarization; 2) Use the large amplitude, highly coherent shear Alfvén wave generated by the maser to investigate several problems of current interest to space and laboratory researchers; 3) Explore the possibility of developing a new Alfvén maser that operates in the compressional-mode of polarization.

Under the guidance of **Claudio Pellegrini** and **James Rosenzweig,** the Particle Beam Physics and Advanced Accelerators group has seen many important research achievements in their development of novel laser and plasma accelerators and advanced sources of X-rays. The Inverse Free-electron laser accelerator at their UCLA Neptune Laboratory, in collaboration with the Kurchatov Institute, obtained the world record energy increase of an electron beam for a laser based acceleration system. Using a 400 GW CO2 laser and a specially built undulator magnet, electrons were accelerated from about 15 to 35 MeV in 25 cm. The study of this type of advanced laser accelerator and its applications will continue with the goal of designing a 1 GeV accelerator. The Inverse Compton Scattering system (collaboration based at Livermore) produced the highest number of x-rays in a single, 10 picosecond long pulse.Free Electron Laser work has been fruitful with continued experimental results from the VISA II program (at BNL's ATF) and pioneering contributions to the computational and theoretical understanding of the novel and groundbreaking X-ray FEL (collaboration based at SLAC).

Zvi Bern is the organizer of the "computational quantum field theory session" at the International Conference of High Energy Physics (ICHEP) 2004 in Beijing, China.



Magnetic Fields (as vectors) and currents (red and green surface plots) in the laser plasma experiment

The magnetic field vectors acquired on the closest plane (z=4 cm) clearly show the field expelled from the plasma bubble. The diamagnetic cavity collapses within two microseconds, but the field-aligned current system associated with the Ipp serves as an antenna for shear Alfvén waves. As the plasma expands across and along the ambient magnetic field, more current systems are generated and a chain of Alfvén waves ensues.

Faculty

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
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
Michael Jura
Vice Chair For Astronomy and Astrophysics
Steve Kivelson
Matthew Malkan
Ian Mclean
George J. Morales
Warren Mori
Mark Morris
Bernard M.K. Nefkens
William Newman
Rene Ong
C. Kumar N. Patel
Roberto Peccei
Vice Chancellor For Research
Rene Pellat
Deceased 08/04/2003
Claudio Pellegrini
Chair Of Physics and Astronomy
Seth J. Putterman
James Rosenzweig
Joseph A. Rudnick
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
Chun Wa Wong
Edward Wright
Benjamin Zuckerman

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

Hans E. Bommel
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
Eugene Wong
Byron T. Wright

Researcher

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

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

Sr. Lecturer SOE

Arthur Huffman

UCLA Distinguished Teaching Award

"….. Mark Morris is not only a great teacher, but he has that unique capability of touching and changing lives."

Mark Morris was selected for a UCLA Distinguished Teaching Award for the 2003-2004 academic year. The goal of the award is to increase awareness of UCLA's leadership in teaching and public service by honoring individuals who bring respect and admiration to the scholarship of teaching. Selection of recipients is based on recommendations made by the Committee on Teaching.

The Magic of Physics

Young people fascinated by the magic of physics at the Celebration of Flight commemorating the historic 1903 flight of the Wright Brothers at Kitty Hawk, North Carolina. The event was sponsored by Celebra la Ciencia (CLC) in collaboration with the California Science Center .

Margaret G. Kivelson

April 12, 2004, **Ian McLean** was selected by UCLA students for honorary membership of the Golden Key International Honor Society in recognition of his contributions to student teaching. Golden Key is an internationally recognized academic honor society dedicated to excellence. Membership is by invitation only.

Graduate Student **Kyle Strohmaier** illustrates current induction to a curious young man

Origin and Evolution of the Cosmos and Life.

Mark Morris is founder and coordinator of a cluster series, "Origin and Evolution of the Cosmos and Life." This is a series of courses taught by UCLA's most distinguished faculty–a means of introducing non-science freshmen to the ways in which all natural phenomena (astronomy, biology, and geology) are interrelated.

LArge Plasma Device Students

After earning his Ph.D., **Mike Van Zeeland** received a postdoctoral position at the fusion facility at General Atomics in the summer of 2003 . In 2004, **Nathan Palmer** will receive his doctorate for work done on measurement of ion motion in the electric fields of Alfvén waves. Over the academic year undergraduate students **Mio Nakimoto** and **Stefan Gruenspan** worked on the LAPD and they will both stay on for the next year. Presently graduate students **Andrew Colette, Eric Wang, Brett Jacobs,** and **Bart Van Compernolle** are doing their thesis work on the LAPD and engineering student **Janet Stillman** is working on the development of microprobes for plasma measurement.

Saxon Lecture 2003-2004

Margaret G. Kivelson of the Earth and Space Science Institute of Geophysics and Planetary Physics at UCLA was this year's Saxon lecturer. Professor Kivelson gave a talk on "The Physics of Planetary Magnetospheres" which described some of the key properties of magnetospheres and discussed some of the different features that have been observed. The relative importance of internal plasma sources (moons, the ionosphere) and external sources; such as the solar wind or a rotating magnetospheric plasma, is also significant. Comparison of planetary magnetospheres with that of Earth's highlights the effects of unusual plasma sources and exotic energy supply mechanisms, and dramatizes the role of the confining plasma.

Katsushi Arisaka *and* ***Alexander Kusenko*** *have developed and taught, for the first time, two new courses: 128 and 226E, "Particle Astrophysics" for undergraduate and graduate students, respectively.*

NSF-Sponsored Outreach

The UCLA Basic Plasma Physics Laboratory Research faculty members, **George Morales, Phillip Pritchett, Jean-Noel LeBoeuf, Frank Tsung,** and **Manuel Urrutia**, along with graduate students **Adrian Soldatenko, Kyle Strohmaier, Humberto Torreblanca,** have continued outreach at several science fair events this year where basic physical principles where presented. Celebra la Ciencia (CLC) is an organization devoted to increased participation of Latinos in science and family health programs. As part of the NSF-funded mission, CLC collaborated with the California Science Center in commemorating the historic 1903 flight of the Wright Brothers at Kitty Hawk, North Carolina. The event took place on November 15-16, 2003. UCLA's Plasma Science and Technology Institute research faculty members, Phillip Pritchett, Jean-Noel LeBoeuf, Frank Tsung, and Manuel Urrutia and graduate students Adrian Soldatenko and Humberto Torreblanca manned a booth where hands-on physics demonstrations were offered. Then on March 28, 2004 the CLC–NSF funded mission partnered with the Cesar Chavez Commemoration March Committee and held a science fair at the San Fernando Recreational park in the city of San Fernando. UCLA research faculty Phillip Pritchett, Jean-Noel LeBoeuf, Manuel Urrutia and graduate student Kyle Strohmaier participated in the hands-on physics demonstrations.

Frank Tsung, a member of the computational plasma physics group headed by **Warren Mori,** joined **Manuel Urrutia** on Saturday, April 3, 2004, at a San Fernando Girl Scout Council Science Fair which took place at a hangar in the Van Nuys Airport. The fair was opened by Councilman Tony Cardenas, who spoke to the girls on the importance of science education. Mr. Cardenas, a UC Santa Barbara-trained electrical engineer represents the 6th District (Northeast San Fernando Valley) on the Los Angeles City Council.

Girl Scouts are electric

Dissertation Year Fellowship

The University of California's Dissertation-Year Fellowships are awarded to outstanding Ph.D. candidates during their final year of graduate school, providing support which allows them to focus on writing their dissertation. There is a campus-wide competition for these fellowship awards each year, and it is quite an honor to be selected as a recipient. This year four dissertation year Fellows have been selected from the physics and astronomy department. They are: **Carlos Camara, Vassili Ivanov, James Kniep**, and **Lee Loveridge.**

GAAN Fellowship Recipients

The four U.S. Department of Education Graduate Assistance in Areas of National Need recipients for 2003-2004 were: **Bijan Berenji, Bertrand Biritz, James Hansen, Pricilla Kurnadi**, and **Gabriel Plunk**. These fellowships are prestigious and competitive.

Andrew Collette, standing beside the LArge Plasma Device (LAPD), is one of the grad students who is presently doing his thesis work on the LAPD

REU Physics & Astronomy Program

In the summer of 2003, the department of physics began a new venture, the NSF-sponsored Research Experience for Undergraduates, a 10-week immersion in research for physics students competing to come to UCLA from all over the U.S.A. The program was proposed and organized by **Françoise Quéval,** undergraduate advisor, and **Professor Walter Gekelman.** The initial funding will last through 2005. In 2004, 13 students were selected from over 250 applications. Participants accepted into this program are matched with a faculty mentor according to the student's stated interests, and a 10-week research project is designed and carried out in close collaboration with that faculty member. The program culminates with oral presentations at a day-long symposium and with the production of professionally formatted research papers. Along the way, participants hear seminars in which faculty members describe their research; they undertake several field trips in the southern California area; and they are offered tutorials in such things as computing, writing, machine shop, and strategies for the physics GRE exam. In many cases, the students who discover UCLA through this program express an interest in returning for graduate school, and in all cases, the students discover or broaden their capacity to do high-level research.

REU students, summer 2003

***Eric D'Hoker** is developing a ``scientific writing'' graduate course for the Graduate Assistants in Areas of National Needs (GAANN) program at UCLA.*

New Faculty

Thomas Mason

Thomas Mason received dual B.S. degrees in electrical engineering and physics with high honors from University of Maryland – College Park in 1989. As a National Science Foundation graduate fellow, he attended Princeton University, receiving an M.A. in physics in 1992. His dissertation research in complex fluids was under the direction of Dr. David A. Weitz at Exxon's Corporate Research Laboratory, leading to a Ph.D. in physics in 1995. He then joined the CNRS, a physical chemistry research laboratory, in Bordeaux, France, as a postdoc. Mason spent one year as a postdoctoral researcher at Johns Hopkins University, working with researchers in chemical engineering and biomedical engineering. For six years he worked as a staff scientist at ExxonMobil's Corporate Strategic Research laboratory. Thomas Mason joined the faculty of UCLA's Department of Physics and Astronomy as an assistant professor in July 2003. Professor Mason holds a joint appointment in the department of chemistry and biochemistry and is the first McTague Career Development Chair. Mason's present research interests focus on the synthesis and applications of nanoemulsions, the structure and rheology of novel concentrated particulate dispersions made using optical lithography, and the development of optically driven microrheology and microfluidic devices.

Jianwei (John) Miao

Jianwei (John) Miao earned his doctorate in physics from the State University of New York at Stony Book in 1999. He was a staff scientist at the Stanford Synchrotron Radiation Laboratory, Stanford Linear Accelerator Center before joining UCLA. His research interests lie in the interplay of physics, nanoscience and biology. He is particularly interested in developing new physical methods for quantitative imaging of nanoscale materials and biological specimens in three dimensions. He has played a major role in pioneering a three-dimensional imaging approach based upon the principle of using coherent diffraction in combination with a method of direct phase recovery called oversampling. At UCLA, he will continue to improve the spatial resolution of this imaging technique and pursue its applications in nanoscience and biology by using lasers, coherent X-rays and electrons.

Vladimir Vassiliev

Vladimir V. Vassiliev received his undergraduate education at Novosibirsk State University in Academtown, Russia, and earned his doctorate in physics from the University of Minnesota in 1997. Before joining UCLA he was a postdoctoral researcher at the Fred Lawrence Whipple Observatory of the Harvard-Smithsonian Center for Astrophysics and an assistant professor at the University of Utah. Dr. Vassiliev's research interests lie in the areas of computational, experimental, and theoretical astrophysics related to the study of production and propagation of very high energy photons in the Universe. Currently, his research is based on observations obtained with the 10m gamma-ray telescope of the Whipple observatory on Mt. Hopkins, Arizona. Together with UCLA professor Rene Ong, he is collaborating in a new ground-based gamma-ray observatory, VERITAS, which will begin operating on Kitt Peak, Arizona, in 2006. Dr. Vassiliev is responsible for the development of the level-one trigger for the instrument and provides simulation support for his collaborators on the project.

New Books by Faculty Authors

Quantum Mechanics, published by Prentice-Hall (2004), written by **Ernest Abers**. A graduate textbook on quantum mechanics.

Fundamentals of Beam Physics, published by the Oxford University Press, written by **James Rosenzweig** during the teaching of Physics 150, The Physics of Charged Particle and Laser Beams, at UCLA.

Elements of the Random Walk. An introduction for Advanced Students and Researchers published by Cambridge University Press in January 2004, written by **Joseph Rudnick,** and George Gaspari.

Out of the Shadows: Contributions of Twentieth Century Women to Physics, edited by **Nina Byers** and **Gary Williams**, is to be published by Cambridge University Press.

In Memoriam

Rene Pellat 1936 - 2003

Professor René Pellat passed away on August 4, 2003 at the age of 67. After being a frequent visitor to UCLA during the 1970's and 1980's, Professor Pellat joined the faculty in 1989, spending part of the year in residence while continuing an increasingly distinguished career in France. Professor Pellat was a long-time Corresponding Member of the French Academie des Sciences, and, in 1986, he became a Directeur de Recherche de Class Exceptional – the highest position in the French Centre National de Recherche Scientifique (CNRS).

Professor Pellat's scientific accomplishments place him at the pinnacle of theoretical plasma physicists. With Professor G. Laval, René founded the discipline of modern plasma physics in France, and at l'Ecole Polytechnique established a world class theoretical program in the physics of high temperature plasmas with applications to magnetically and inertially (laser) confined fusion plasmas, space plasma physics, and plasma astrophysics. In the 1960s Laval and Pellat authored the classic paper on the collisionless tearing instability, and joined by Professor B. Coppi, proposed that magnetospheric substorms commenced with the onset of tearing mode reconnection. In the 1970s with Laval, René pioneered the investigation of internal kink and ballooning instabilities in Tokomaks using collisionless plasma theory in general magnetic geometries. Later, René applied the same analytical techniques to understanding the stability and dynamics of the near-Earth region of the geomagnetic tail; a milestone of this effort was the beautiful UCLA Ph.D. dissertation of Omar Hurricane. René also trained students in theoretical astrophysics, who went on to establish research groups (with René as the grey eminence) in plasma astrophysics, planetary formation, and cosmology. Rene and his students showed that the standard Lin-Shu theory of galactic spiral density waves also contained the heretofore unexplained bar modes and advanced the kinetic theory of gravitational interactions.

Starting in 1989, Professor Pellat held a sequence of very high level positions in France: Président du Conseil Administration du CNRS; Président du Centre National d'Études Spatiales (CNES); and Haut-Commissaire à l'Energie Atomique (CEA). From his CEA position René reorganized the ITER project, bringing together an international consortium (Europe, Canada, Russia, Japan, China, and Korea) and even arranging for the U. S. to rejoin ITER.

René's words were often in conflict with his actions. He claimed to pursue science as a game just to have fun. Yet, no one was more passionate about science or more devoted to the search for scientific truth. He always used the power associated with his very high positions to advance the progress of science. René was often rough of manner and brutally frank in his critiques. Yet, he trained, nurtured, and found positions for a cadre of brilliant French students to whom he remained unfailingly devoted. At UCLA, those who knew and worked with René became members of his extended "family," and came to treasure their relationship with him. He left us much too soon.

Hans Boemmel 1912 - 2004

Professor Hans E. Boemmel (Bömmel) died March 19, 2004, in Heiden, Switzerland at the age of 91. A citizen of Switzerland, he was born October 15, 1912. He studied physics in Zurich, Switzerland. In the 1950's, Hans immigrated to the United States and worked on ultrasonics at Bell Laboratories. His research there included extending ultrasonic techniques into the gigahertz frequency range (in collaboration with Klaus Dransfeld) and the use of ultrasonic methods to study superconductivity. In 1961, he joined the faculty of the UCLA Department of Physics, where he pioneered the technique of acoustic nuclear spin resonance and its application to investigate superconductivity. In 1968, he left UCLA to become the first physicist hired by the University of Konstanz in Konstanz, Germany. There he became Chair of that Department and guided it to a high level of recognition in the scientific community. Two of the early postdoctoral researchers in his group at Konstanz, John A. McNeil and Allen L. Kerlin, obtained their Ph.D. degrees in condensed matter physics at UCLA.

Jack Brooks May 5, 2004

Sadly, Jack Brooks, the retired engineer who volunteered his time in our tutoring center for the last 12 years, helping our students with the challenges of physics and thus providing a substantial service to our department, passed away. On his way home from UCLA by bicycle, he was struck by a car. He died of his injuries on May 5, 2004. Jack received his Bachelor's degree in Physics from Texas A&M University and his Ph.D. in Physics from Oxford University. Upon finishing graduate school, he went to work as an aerospace engineer, first at Public Aviation in New York for three years, then at TRW in Los Angeles for 36 years. Right after retirement in 1992, he volunteered his time two days a week in our tutoring center and continued to do so until his untimely death.

Graduates

Bachelor of Science Degrees Awarded

Astronomy

Matthew Bottomly
Punjatorn Chanudomchok
Jonathan Golub
• Fellowship to pursue graduate studies at Washington & Lee University Law School
Gabriel Guevara
Stephanie Herczog
Freya Hourani
Lisbeth Jensen
Gabriel Juarez
Michael Rosenbach
Kyle Stewart
• Full fellowship to pursue graduate studies in astrophysics at UC Irvine
Andrew Stine
Devin Waller

Physics

Richard Amerine,
Kenneth Anderson
Max Comess
• Full fellowship to pursue graduate studies in physics at UC Santa Cruz
Andrew Delpit
• 2003 STINT research fellowship
Hsiang-Tai Dou
Mohamed Elghefari
Ricardo Garnica
John Goetz
• Fellowship to pursue graduate studies in physics at ` UCLA in High Energy Particle Physics
Benjamin Golden
• Full fellowship to pursue graduate studies in physics at UC Irvine
Eric Hennigan
Karin Hill
Matthew Jones
Brian Jurglewicz
• Full fellowship to pursue graduate studies in theoretical physics at the University of Michigan
Matthew Kennedy
• Full fellowship to pursue graduate studies in electrical engineering at Cornell University
Reza Kialashari
Johan Lindqvist
Matyas Matolcsi
Jason Minamora
• Full fellowship to pursue graduate studies in experimental high energy physics at Caltech
Awrasa Montchirock
• Abelman-Rudnick Scholarship recipient 2001-02
Astrid Morreale
Christopher Muller
Mio Nakamoto
Elias Paris
• Full fellowship to pursue graduate studies in Physics at CSU Northridge
Lara Pierpoint
• NSF fellowhip to pursue graduate studies in physics or a physics-related field at any university of her choice
Salameh Rabadi
• Abelman-Rudnick scholarship recipient 2002-03
Thomas Roche
Sara Salha
Alexandre Savichev
Kristjan Stone
• President of the Society of Physics Students
Herbert Sutherland
Kathryn Tschann-Grimm
• Full fellowship to pursue graduate studies in physics at the University of New York, Stony Brook
Eason Wang
Jeremy Werner
• Full fellowship for graduate studies in Physics at Princeton University
Oliver Williams
Jeffrey Wright
• 2003 STINT research fellowship
Han Yan
Vitaley Zaretskey
• Full fellowship to pursue graduate studies in physics at the University of Maryland, college Park
Mario Zunic

Bachelor of Arts Degrees Awarded

Bergel, Dennis
Kyriazis, Stephanie
Olivieri, Melisa
Szupinski, Konrad

Graduates

Doctoral Degrees Awarded

Astronomy

James Colbert
Alex Markowitz
- Cota-Robles 1998-1999 & 2001
- Research Mentorship 2001-2002
- Dissertation Year Fellowship 2002-2003

Angelle Tanner
- Cota-Robles 1996-99
- Dissertation Year Fellowship 2001-2002

Dawn Williams
- Chancellor's Fellowship 1999-2000
- Dissertation Year Fellowship 2003-04

From left to right: Dawn Williams, Weiqiang Yu, Masaki Shigemori
Han-Ching Chu Czarnecka, Shawnoah Pollock, Makan Mohageg

Condensed Matter Physics

Han-Ching Chu Czarnecka
- Camp Fellowship 1997-1998
- Outstanding Teaching Assistant 1998-1999
- Outstanding Teaching Assistant 1999-2000
- PAAL Outstanding Graduate Student Award 2003-04

Xiao Yang

Elementary Particle Physics

David Goldstein
Ping He
Matthew Worcester
- Camp Fellowship 1998-1999

Nuclear Physics

Yu Chen
Paul Sorenson
- 2004 Outstanding Thesis Award from RHIC (Relativistic Heavy Ion Collider group)

Theoretical Elementary Particle Physics

Anton Ryzhov
Henry Wong
Masaki Shigemori

Accelerator Physics

Matthew Thompson

Paul Sorensen, *who did his thesis at UCLA joined the STAR collaboration in the fall of 2000 to study kaon production in heavy ion collisions. His thesis " Kaon & Lambda Production at Intermediate Transverse Momentum (pT): Insights into the Hadronization of the Bulk Partonic Matter Created in Au+Au Collisions at RHIC" won the Relativistic Heavy Ion Collaboration thesis award in June 2004.*

Abelman-Rudnick Scholarship Recipients 2003-04

From left to right Joseph Rudnick, Ryan Eagle, Hripsime Topchyan and Noel Velasco