UCLA

Department of Physics & Astronomy

University of California Los Angeles

Annual Report 2002 | 2003

Department of Physics and Astronomy 2002 - 2003

University of California Los Angeles

Physics and Astronomy Department
2002-2003

Chair
Claudio Pellegrini

Editor
Barbara L. Pawley

Assistant Editor
Mary Jo Robertson

Contributing Editors
Friedel Adler, Carol Finn, Andrea Johnson, Joyce Norton, Francoise Queval

Photography
Andrea Johnson, Matthieu Morris

Design
Mary Jo Robertson

Cover (designed by *Mary Jo Robertson*)

This report covers the period July 1, 2002, through June 30, 2003.

Requests for additional copies of the publication
Department of Physics and Astronomy
2002-2003 Annual Report may be sent to:

Office of the Chair
UCLA Department of Physics and Astronomy
405 Hilgard Avenue - Knudsen Hall
Box 951547
Los Angeles California 90095-1547
Phone (310) 825-3440

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

Contents

Message from the Chair

Thanks to the efforts of our faculty and staff, the Department of Physics and Astronomy has realized major academic achievements during the year. Results of the research conducted by our faculty are discussed in the Research Highlights portion of this report. The list is by no means exhaustive, but represents a major part of our accomplishments during the period. The department continues to see an increase in grant support and research activity.

In terms of education, we are proud to announce new fellowships and new teaching programs, which are discussed in the Education Highlights portion of this report. The National Science Foundation awarded the department a Research Experience for Undergraduate Students (REU) grant, which was a highly successful summer program. We are participating in a new, five-year graduate fellowship program sponsored by the Department of Education, as well as a three-year fellowship program sponsored by the Department of Energy. Our graduate students have received 10 national fellowships this year, primarily from the National Science Foundation and the Department of Education.

We have introduced a new, groundbreaking undergraduate major in biophysics. Students enrolled in this interdisciplinary program will be simultaneously educated in physics and biology, especially with regard to the research methods and languages of the two sciences. We expect them to move on to industrial or research and academic careers in biophysics and biology. The department has initiated the Program for Excellence in Education and Research in the Sciences (PEERS), jointly developed with the physical and life sciences departments to assist and mentor less advantaged students.

Construction of the new physics and astronomy building is well under way. We expect to occupy the laboratories during the winter of 2004. Faculty, staff and students will move into the building before the end of the spring quarter. We are looking forward to new classrooms with modern audiovisual capabilities, including internet access, and to new laboratories with a total absence of vibration and an extremely clean environment. This is necessary for advanced experimental research.

It has been a pleasure to participate in the 2002 graduation ceremony for our undergraduate and graduate students. I wish them all the best for their future careers. Recruitment of new graduate students for 2003–2004 was very successful. Thirty-eight students were selected from more than 300 applicants. I want to take this opportunity to welcome them to UCLA.

We are pleased to introduce four new faculty members: Troy Carter, Michael Gutperle, Bradley Hansen and Rainer Wallny. They will enrich our research and teaching programs. We are saddened by the loss of two faculty members who greatly contributed to the university and to physics: Lawrence Aller and Burton Fried. We will miss them and remember them as part of our family of scientists and educators.

The faculty and I wish to express our deep gratitude to all the donors for their support, and for giving us a better opportunity to carry out our teaching mission and extend our knowledge of nature.

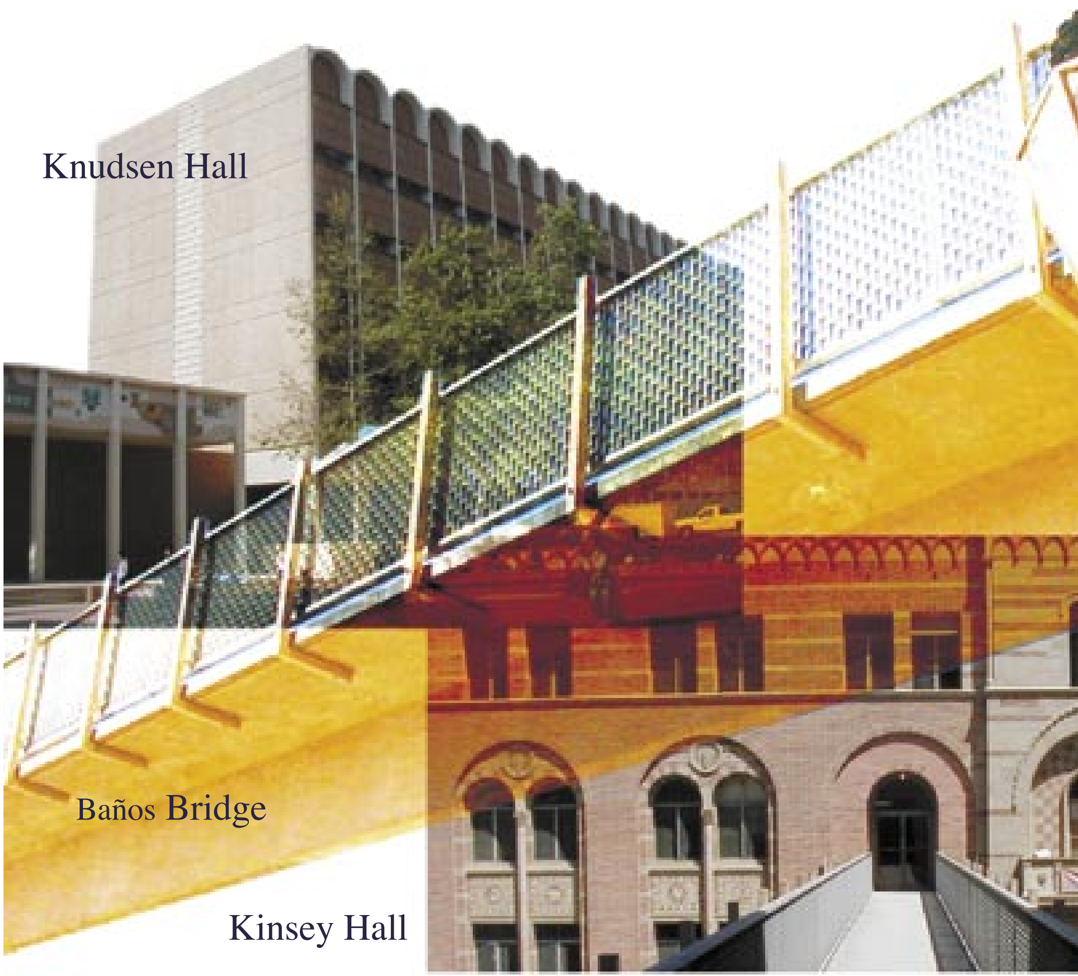
Claudio Pellegrini

The Men Their Buildings & Their Bridge

Vern O. Knudsen

Alfredo Baños Jr

Edgar Lee Kinsey



The Men Their Buildings and Their Bridge

The UCLA Department of Physics opened in September 1919 with one professor, **John Mead Adams,** who proceeded to teach physics with three bricks he collected from a construction site and three spring balances he brought from home. The UCLA campus officially did not yet exist; the first recipients of bachelor's degrees in physics graduated from the "University of California Southern Branch."

Vern Knudsen was born on a farm in Provo, Utah, in 1893. After earning his bachelor's degree, he worked at Bell Telephone Laboratories where he collaborated in the development of vacuum tube technology. He served in both world wars as a dedicated researcher, playing a key role in anti-submarine efforts during World War II. Between the wars, he earned a doctorate, applying acoustics to the problem of hearing. He came to UCLA in 1922, developing the field of acoustical physics, for which he became an international success. He was instrumental in establishing the graduate division at UCLA, and became its first dean, serving from 1934 to 1958. He was appointed vice chancellor in 1956 and chancellor in 1959. Mandatory retirement a year later provided him the opportunity to return to his research. He died of pneumonia in 1974 at the age of 80.

Knudsen

In 1922 **Vern O. Knudsen** arrived, eventually becoming the third chairman of the department, the first dean of the graduate school, vice chancellor and then chancellor of UCLA. His contributions to the university's development are only eclipsed by his international renown in acoustical physics. An ardent researcher, author, and consultant, his principles in architectural acoustics became the foundation for the design of contemporary soundstages. During his remarkable career, Knudsen designed the acoustics for over 500 structures, including the Los Angeles Music Center and most of the Hollywood sound stages. In 1964 when it came time to name the building that would become home for the department for the next 40 years, the logical choice was this eminent scholar and administrator, and Knudsen Hall came into being.

Knudsen recruited **David Saxon** in 1947 when UCLA was still largely unknown and crisscrossed by dirt footpaths. Saxon went on to become department chair, dean and finally UC President; he is currently emeritus. Saxon remembers, "Vern provided the department with celebrity and a focus for research and teaching. He created an egalitarian environment when it came to meeting and decision-making. This allowed the young faculty as much of a voice as the senior ones. I remember him as gregarious, cultivated and worldly, a person who made things possible."

When faculty and staff occupy their new building next year, Knudsen Hall will undergo refurbishment to modernize and expand the department's teaching facilities. Seven new lower division teaching laboratories will be added for introductory physics courses; and new upper division teaching laboratories will include a domed heliostat for astronomy classes and a new plasma physics laboratory. Renovation of the infrared astronomy research laboratory is also planned (but not yet funded). For the first time in the department's history, graduate students will have adequate offices. Three existing auditoriums are scheduled for renovation and will be named collectively, the Kinsey Lecture Halls, continuing the legacy of another physicist who became a university leader.

---

*Professor **Seth Putterman** remembers his first meeting with Vern Knudsen."I started up a conversation and Vern immediately held up his hand, then proceeded to pull earplugs out of his ears. He explained to me that hearing naturally wears out over time due to the cumulative effects of sound. So he had been diligently designing and using earplugs since the early twenties. A recent hearing test revealed that his hearing matched that of a teenager. His "ear defenders" are used today by coal miners.*

Kinsey

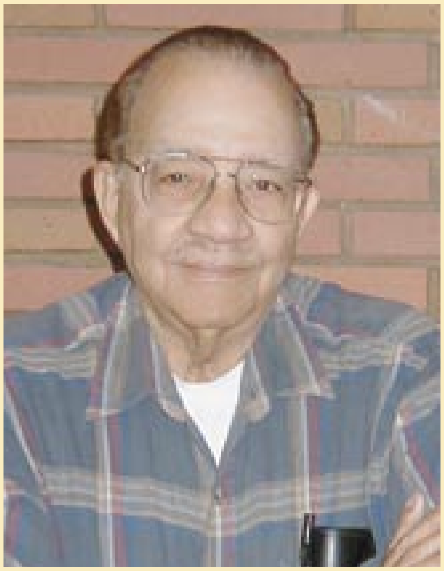
Kinsey Hall is one of the four original UCLA buildings. All were designed to give the new campus a distinctive architectural style, featuring warm Mediterranean coloring and rounded Roman arches, based on the architecture in northern Italy. Only Royce Hall has borne the same name since the campus opened. The other three buildings had generic names until later in their history. Originally known as the physics-biology building, Kinsey Hall was dedicated in 1964 to honor **Edgar Lee Kinsey,** professor of physics and former chair of the department. He taught at UCLA from 1928 until his death in 1961 from a heart attack, suffered during an Academic Senate debate. Kinsey was nationally known for his work in spectroscopy. He made numerous contributions to the fields of optics and solid-state physics that, in turn, proved important in the development of transistors. Saxon remembers, "It was recognized that Lee literally gave his life to UCLA, so the building was named after him to acknowledge his commitment to the university." With the construction of the new physics and astronomy building in 2004, Kinsey Hall will be designated for humanities and renamed.

David Saxon

Baños

Alfredo Baños Jr., arrived in the department in 1946 and occupied a second-floor office in Kinsey Hall. He was one of the first physicists to pursue theoretical plasma physics. He was a precise man, an impeccable dresser and had a flair for the dramatic. Years later, after Knudsen Hall was completed, a new second-story bridge was planned to connect the two buildings. Unfortunately, the bridge completely eliminated the office that Baños had so carefully occupied. To compensate, his friends in the department named the connecting footway Baños Bridge. It was formally dedicated in 1963.

The pioneers who devoted their careers to UCLA and physics were not all academic stars. After serving in the United States Army during World War II, including participation in D-Day, **Curt Hamblin** began working for the department in 1956. He has had the same job for 47 years, cheerfully procuring and distributing supplies to the researchers who have occupied the laboratories in Knudsen and Kinsey Halls. He is the oral history for the small details that get lost over time. He recalls, "One of my jobs was to go out and buy blank cartridges for the gun that Knudsen used in the dead room." The anechoic chamber and the reverberation chamber (live room) were central to acoustical physics in the mid-20th century when Knudsen Hall was planned. Because of the way it was constructed, the dead room has become an ideal place to calibrate instruments.



Curt Hamblin

Donors

Regental Fund
Michael Allen Kriss
Zenon Neumark
Alfred P. Sloan Foundation

The John Dawson Memorial Fund
Boyd B. Cary
Yukiharu Ohsawa
Kaiti Wang

Dr Waldo Lyon Scholarship
Gene L. Bloom
Richard J. Boyle
Jeffrey A. Fischbeck

J. Reginald Richardson Fund
Pamela L. Chrisman
Wells Fargo Bank

Physics & Astronomy Capital Program
Howard J. Preston

Rudnick-Abelmann Endowed Fund
The Morris Foundation Inc.

Condensed Matter Physics Experimental Research Fund
W. Gilbert Clark

Physics And Astronomy Alumni Alliance (PAAL)

Alumni and Friends
Gregory R. Anderson
Michael W. Arenton
Andrew N. Baker Jr.
Robert S. Baker Jr.
James F. Bamber
Arnold Benton
Donald A. Berk
Jean Biddick
Nicholas Bottka
Thomas B. Brown
Ralph V. Chamberlin
Soong-Tao Chiang
Howard L. Christensen
John G. Coffer
James W. Craft
Bernd Crasemann
Donna Dameron
James A. Dixon
Steven T. Donovan
Thomas L. Drouet
Harold B. Eaton
Gordon E. Eggum
James D. Enright
Hina M. Fagu
Thomas A. Ferguson III
Ivan L. Finkle
David Fiske
Frank S. Fontanella
Barry J. Forman
James C. Fraser
Howard R. Friedrich
Anthony F. Gangi
David R. Garfinkle
Stephen J. Gayer
Frank J. Goebels Jr.
L. Stephen Graham
Frank R. Graziani
Alexander Grigorian
Jean-Michel Guerin
William F. Hall
Bernard Hamermesh
Aaron J. Heick
Takeo T. Hirai
Joseph F. Hook
Edward L. Hubbard
Jerald R. Hyde
William N. Jacobson
Inge Jechart
Louis K. Jensen
Hiroshi Kadogawa
Alan R. Katz
Robert D. Kaufman
Charles F. Kennel
Tae W. Kim
Beth L. Klein
Kenneth D. Knight
Justin S. Kocher
Robert P. Korechoff

Michael Allen Kriss
Joel S. Kvitky
Pyung S. Kwon
Perry E. Lanaro
Erick L. Lindman Jr.
Hue B. Loo
Allen Mann
Myron A. Mann
Nickolaos Mastrodemos
Timothy K. Mc Donald
Roland P. Michaelis
Gilbert A. Miranda
Makoto Nagata
Stephen R. Neal
David M. Pepper
Dusan Petrac
Samuel Prum
Lawrence S. Quimby
Erno H. Ross
Lawrence Ruby
Mendel Sachs
Philip J. Sakimoto
Joseph Santoru
Douglas W. Scharre
Judith S. Schrier
Gregory R. Schultz
Larry L. Simmons
Edward J. Smith
Lewis T. Smith
Lawrence P. Staunton
Dean M. Sumi
Yi Tang
Kenneth L. Telschow
John C. Tompkins
Susan E. Turnbach
Richard J. Wagner
Anne Wang
Zhengzhi Wang
Guy M. Weyl
Gordon R. White
Chun Wong
John J. Wood Jr.
Thomas J. Woods
Byron T. Wright

Corporate and Foundation Gifts

Hayden-McNeil Publishing Inc.
IBM International Foundation
Marcos & Ilene Lederman Philanthropic Fund / Jewish Community Federation
Lockheed Martin Corporation Foundation
Myers Dawes & Andras LLP/Dan Dawes
Northrop Grumman Litton Foundation
Raytheon Systems Company
Scheifele-Holmes Family Foundation /Fidelity Investments
Thermal Computations, Inc.
Universal Studios, Inc.

Howard J. Preston Gift

Support for the New Physics and Astronomy Building

The Department of Physics and Astronomy has been fortunate to receive a generous gift from alumnus Howard J. Preston to support the new building which is under construction and slated for completion in early 2004. In making this gift he emphasized the importance of the building in enhancing the department's competitive advantage. He also applauded its role in the collaboration of two previously disparate fields. Said Preston "The merged physics and astronomy facilities will help to provide us with a more coherent picture of nature from the scale of elementary particles to that of the Universe itself." Preston received both his bachelor's degree (1965) and doctorate (1974) from UCLA. He is currently President of Preston Cinema Systems Inc. an innovator in camera and lens control systems used in movies such as *Minority Report* and *The Matrix: Reloaded.*

Donors

Benefactors

Richard J. Boyle
Thomas B. Brown
Pamela L. Chrisman
W. Gilbert Clark
Fidelity Investments/Scheifele-Holmes Family Foundation
Hayden-McNeil Publishing, Inc.
Michael Allen Kriss
Marcos & Ilene Lederman
Philanthropic fund/Jewish Community Federation
The Morris Foundation, Inc.
Myers Dawes & Andras LLP/Dan Dawes
Zenon Neumark
Yukiharu Ohsawa
Howard J. Preston
Alfred P. Sloan Foundation
Wells Fargo Bank
Byron T. Wright

After 35 years, the Leonard Student and Faculty Lounge in Knudsen Hall needs a facelift. Used heavily by graduate students for study and relaxation, by the Undergraduate Physics Society for meetings, and by faculty and staff for colloquia and other special events, it has reached a sad state of deterioration. Given the financial situation of the university, this renovation cannot be funded by instructional resources. The department has launched a campaign to raise money through donations, large and small. The needs are basic: new carpet and furniture for the lounge itself, and resurfacing of the patio. The total cost is estimated at $30,000. To date the campaign has brought in $5000. Please see our website http://www.physics.ucla.edu/lounge/index.html for more information about how to donate. A wall plaque will honor those who have supported the refurbishment.

Leonard Lounge Fund has raised $5000. as of July 2003

Robert W. Leonard, from March 1948 issue of California Monthly

The first set of muon detectors after installation in the CMS experiment at CERN. The top of the disk of detectors is at a height of 15 meters (49 feet). UCLA physicists built high-speed electronics located on each detector, and provided the final assembly and testing of these detectors. *See section on Experimental Elementary Particles*

This photograph shows the center of the 2.85 MHz Hertzian dipole showing the self firing pressurized SF_6 spark gap; Tesla primary and secondary antenna charging coils; and the antenna current monitoring transformer above the spark gap electrodes. *See section on Plasma and Advanced Accelerators*

The first VERITAS 12m Cherenkov telescope under construction at the Base Camp of the Whipple Observatory, at Mt. Hopkins, Arizona. *See section on Astroparticle Physics*

Galactic Astronomy

Eric Becklin was named director of the SOFIA program (Stratospheric Observatory for Infrared Astronomy).

Eric Becklin has continued his work as Chief Scientist on the SOFIA (The Stratospheric Observatory for Infrared Astronomy) project. SOFIA has reached an important milestone this year with the integration of the telescope assembly into the SOFIA aircraft, a Boeing 747-SP. The telescope assembly weighs over 14,000 kg and consists of 1.2 meter hydrostatic bearing, 2.5 meter primary mirror and the metering structure for the secondary mirror. The aircraft underwent considerable modification in readiness for the telescope assembly, including construction of an open port for telescope viewing, installation of a bulkhead to support the telescope assembly, and structural reinforcement of the aircraft body.

Over the last year, **Andrea Ghez** and colleagues have obtained two exciting new results with the W. M. Keck 10-meter telescopes. In the research on the Galactic Center, diffraction-limited imaging and spectroscopy have led to the first simultaneous orbital solutions for multiple stars, increasing the implied dark matter density by four orders of magnitude, and thereby dramatically strengthening the case for a supermassive black hole at the center of the Milky Way. Furthermore, the first detection of spectral absorption lines in one of the high-velocity stars revealed that this star appears to be a massive (15 Mo), young (<10 Myr) star. This presents a major challenge to star formation theories, given the close proximity of this star to the central black hole. In research on the formation of stars and planets, imaging at thermal infrared wavelengths has spatially resolved proto planetary disks around the young stars HK Tau B, GG Tau, and HV Tau C. These are the first examples of protoplanetary disks observed in scattered light in the thermal infrared. They demonstrate that these disks contain dust with sizes that are significantly larger than those expected in the interstellar medium, implying that grain growth, the first step toward planetary formation has occurred.

A wide-angle view of the SOFIA telescope through the aircraft opening. The telescope carbon fiber metering structure, including the secondary mirror support, is now mounted on the bulkhead of the aircraft. The primary mirror was placed on the metering structure shortly after this picture was taken. U.S. House Representative Chet Edwards from Waco Texas is standing in the center of the open air cavity.

Brad Hansen and **Michael Rich,** in collaboration with a team lead by **Harvey Richer** from the University of British Columbia, determined the age of our Galaxy by measuring the brightness and temperatures of some of the oldest and faintest stars ever observed. The stars are white dwarfs, burnt out remnants of normal stars and located in a star cluster called Messier 4, at a distance of six thousand light years. Using models of stellar evolution developed by Hansen, and data obtained using the Hubble Space Telescope, the team measured the age of the Galaxy at 12 to 13 billion years. The team also reported the discovery of the oldest and most distant planet yet discovered. This planet orbits a binary star system containing a white dwarf and a neutron star, and is inferred from a combination of observations at both radio and optical wavelengths.

***Rene Ong** was appointed to the National Astronomy and Astrophysics Advisory Committee and the SLAC Experimental Program Advisory Committee.*

Fifteen years ago **Benjamin Zuckerman** and **Eric Becklin** discovered that the white dwarf G29-38 has an infrared excess. The explanation for this excess has been an unsolved mystery until this past year when **Michael Jura** discovered a ring of dust around G29-38 that is very similar to the ring around Saturn in our own Solar System. The dust ring was probably produced from the tidal disruption of an asteroid by the powerful gravitational field of the white dwarf. This discovery explains the infrared excess around G29-38.

The near-infrared camera (FLITECAM) being developed at UCLA for "first light" operation on the SOFIA in 2004 was successfully field-tested on three occasions at the Lick Observatory by **Ian McLean** and UCLA astronomy student **Amanda Mainzer**. The camera was used to search a young star cluster for newly-formed objects as low as 5 Jupiter masses.

A deep observation of the center of the Milky Way Galaxy was made with the Chandra X-ray Observatory by **Mark Morris,** former UCLA graduate student **Fred Baganoff,** and collaborators from Penn State and MIT. This led to several discoveries: 1) a new hour-scale flare from the central black hole of our Galaxy, 2) a probable jet feature emanating from the black hole, 3) large-scale, bipolar X-ray lobes centered on the black hole, 4) over 2300 stellar X-ray sources, and 5) unprecedented detail in the extended, diffuse emission.

The carbon star red giant, V Hydra, was captured by the STIS spectrograph on board the Hubble Space Telescope in the process of ejecting a blob of gas at high velocity (up to 300 km/sec). **Mark Morris** is working on this with collaborators from JPL, Princeton, Valdosta and Harvard.

***Matt Malkan** received a fellowship from the Japanese Society for the Promotion of Science.*

With colleagues from the Jet Propulsion Laboratory, Princeton, Harvard and Valdosta, **Mark Morris** captured the carbon star red giant, V Hydra, using the STIS spectrograph on board the Hubble Space Telescope when it was in the process of ejecting a blob of gas at high velocity (up to 300 km/sec). Such collimated ejections are important for accounting why many of the objects in this category have a bipolar morphology, yet this is the first time that the ejection has actually been imaged at an early stage. This work should help sort out why the ejections are collimated.

Extra-Galactic Astronomy

The UCLA infrared lab is constructing a new, one-ton infrared spectrograph for the Keck Adaptive Optics System. The instrument is called OSIRIS and uses custom arrays of lenses to take up to 4096 spectra simultaneously. This will allow the instrument to produce images of distant astronomical objects at hundreds of different wavelengths at the same time. Its applications include dissecting the internal motions of galaxies in the early universe to discover how they formed, finding non-stellar companions to nearby stars, and even characterizing the surfaces of solar system objects such as Jupiter's moon, Titan. The project group, led by **James Larkin,** is expecting to complete the instrument in the spring of 2004 and commission it at the telescope during the summer and fall.

Mike Jura has been elected to the Board of Directors for AURA, the organization that operates the Space Telescope Science Institute and the National Optical Astronomy Observatories.

FLITECAM on the Lick 3-m telescope

An image of the globular cluster GI (suspected to harbor a 20,000 Solar Mass hole).
Photo Credit: R. Michael Rich and NASA

Michael Rich and **Brad Hansen** led a team that reported the discovery of the first intermediate mass black hole in a globular star cluster, G1 in 31. The Hubble Space Telescope was used to measure the velocity dispersion of stars near the core of G1, and a mass for the central object of 20,000 Solar Masses was derived. Intermediate mass black holes may play a major role in the formation of supermassive black holes in the nuclei of galaxies. The finding received widespread media attention, including a NASA Space Science Update.

Astroparticle Physics

David Cline and colleagues finished building the largest dark matter detector in the world and shipped it to the United Kingdom in the spring of 2003 where it was installed in the Boulby Underground Laboratory. ZEPLIN II is a liquid xenon detector that will use extremely sensitive techniques to search for matter in the Universe that is not accounted for by stars, planets, dust, or other matter. As part of the STELLA II Advanced Accelerator project at BNL, Professor Cline and his group produced the first monochromatic beam acceleration there. They are the first to use advanced accelerator methods to stage a laser accelerator, and have carried out this first stage experiment successfully.

The group led by **Rene Ong** has started regular observations with the STACEE gamma-ray telescope near Albuquerque, New Mexico. This telescope is studying the emission from sources such as active galaxies, supernova remnants, and gamma-ray bursts in an unexplored band of the electromagnetic spectrum. Funding for STACEE observations through 2006 was approved by the National Science Foundation. To take the next step, Professor Ong and colleagues are developing a new state-of-the-art telescope called VERITAS, which will comprise four 12m diameter reflectors in its first phase. The first VERITAS telescope is under construction at the base camp of the Whipple Observatory, at Mt. Hopkins, Arizona.

As Principal Investigator on the Wide-field Infrared Survey Explorer (WISE) proposal, **Edward Wright** won an extended Phase A study that could lead to a launch of this project in 2008. WISE will survey the whole sky in four infrared bands: 3.5, 4.7, 12 and 23 microns with 1000x better sensitivity than previous surveys. WISE will find the most luminous galaxies in the Universe and the closest stars to the Sun. As a member of the WMAP team, Professor Wright found that the Universe is very nearly flat: Omega_tot = 1.02 +/- 0.02.

***William Newman** was Vice-Chair of the Division of Dynamical Astronomy (DDA) of the American Astronomical Society for 2002–2003 and Program Chair for the 2003 meeting. He is chair-elect of the DDA for 2003–2004.*

Nuclear Physics

The central goal of the relativistic heavy ion physics research program is to discover the Quark-Gluon Plasma (QGP), a new state of matter where quarks and gluons become deconfined from individual hadrons over an extended volume. The UCLA group, comprised of **Huan Z. Huang, Charles Whitten** and **George Igo**, has been a leading university group in the STAR collaboration at Brookhaven National Laboratory (BNL) Relativistic Heavy Ion Collider (RHIC) since the inception of the experiment. The RHIC scientific program has made great strides toward the discovery of the QGP. Experimental measurements indicate that gold+gold collisions at RHIC create nuclear matter with unprecedentedly high energy density and temperature. Furthermore, the produced matter exhibits dynamical features quantitatively different from matters created in nuclear collisions at other existing accelerator facilities. The goal of this experimental program in the coming years is to determine the nature of the dense matter created at RHIC and its quark and gluon degrees of freedom. The RHIC spin physics program, using polarized p+p collisions, has also made significant progress in the past year. Faculty have successfully commissioned two spin polarimeters and a spin rotator at the STAR interaction point, enabling collisions between longitudinally polarized p+p collisions that are necessary for measuring the gluon spin structure function of the proton.

STAR Collaboration: Brazil, China, Great Britain, France, Germany, India, Poland, Russia, and United States Labs and Universities.

Condensed Matter

Stuart Brown and colleagues have been studying several different systems with NMR, including organic conductors and high-temperature (cuprate) superconductors. In the case of the former, they recently discovered a completely unanticipated charge-ordered phase that is ubiquitous to a whole class of materials and arises, from long-range interactions that are irrelevant in conventional conductors. In the case of high-temperature superconductors, the nature of the conducting (but not superconducting) phase is a matter of debate. Understanding it is considered an important part of solving the problem. Professor Brown recently started investigating a material in which ordinary laboratory magnetic fields can suppress the superconductivity entirely. The underlying "normal" phase is far from ordinary: experiments indicate it is a very inhomogeneous state, and the inhomogeneity is strongly temperature dependent. It is hoped that future experiments will clarify the nature of the inhomogeneous phase.

Robjyn Bruinsma, with **Joseph A. Rudnick** and colleagues from the UCLA Chemistry Department, developed the first successful physical model for viral self-assembly. Previous studies had failed to reproduce the T-structures and, instead, encountered shells with odd-looking octahedral and cubic symmetries. They showed that an essential feature of icosahedral capsid formation was that the proteins should be allowed to switch between two different states, which in fact is a well-known property of capsid proteins. When they suppress this switching feature in this model, they also run into octahedral, cubical symmetries.

Leon Knopoff was elected Associate of the Royal Astronomical Society in 2003.

Steve Kivelson is interested in the qualitative understanding of the macroscopic and collective properties of condensed matter systems, and on the relation between this and the microscopic physics at the single electron or single molecule scale. More specifically, he has focused his attentions on 1) The amazing electronic properties of the cuprate perofskites, including high temperature superconductivity; and 2) The two dimensional electron-gas in a strong magnetic field, which exhibits phenomena associated with the quantum Hall effect, fractional charge, and fractional statistics. Presently, he is actively pursuing the implications of a theoretical proposal he and his collaborators have recently made concerning the existence and character of a variety of new zero temperature phases of correlated electronic systems. These phases occur as groundstates of interacting electrons in regimes intermediate between the weakly correlated Fermi gas phase observed in conventional metals and the insulating Wigner Crystalline phases that occur when the interactions are large compared to the Fermi energy. They have named these phases, "electronic liquid crystalline," in analogy with the intermediate phases observed in the thermal phase diagram of molecular liquids. Some of them have apparently already been observed recently in high temperature superconducting materials and in quantum Hall devices.

W. Gilbert Clark was elected a Fellow of the American Physical Society for developing magnetic resonance instrumentation and methods, widely disseminating their application, and using them to investigate semiconductors, superconductors, organic conductors, low-dimensional magnets, heavy fermions, and charge and spin density waves.

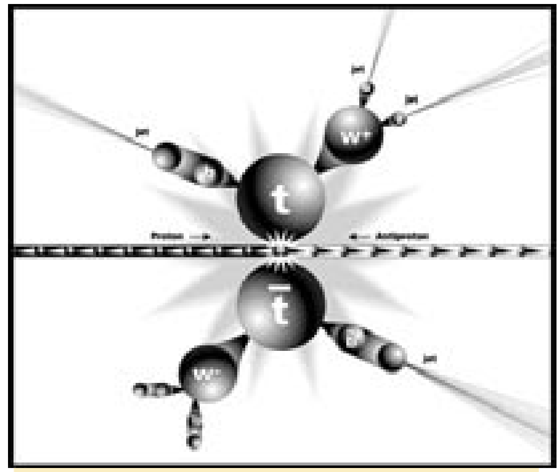
In the last year, **Chetan Nayak,** has focused his research on three main topics: the pseudogap state of the cuprate high-temperature superconductors, non-Abelian braiding statistics in condensed matter systems, and low-energy excitations in disordered systems. He and **Sudip Chakravarty**, along with a number of students and collaborators, have theorized that the DDW state, a broken symmetry state with an alternating pattern of circulating currents, is consistent with angle-resolved photoemission (ARPES) experiments. These experiments were purported to rule out their theory. Professor Nayak and colleagues recently finished a paper in which they described the Hilbert spaces of a class of topological phases of correlated electrons. The structure of these Hilbert spaces strongly suggests what types of microscopic models can give rise to these phases. The long-term goal is to discover or construct a non-Abelian topological state. Such a state would be an attractive arena for quantum computation because universal quantum computation could be performed through braiding operations, while the topological nature of the quantum information would protect it from the local effects of decoherence. Finally with physics student, **Xiao Yang**, Professor Nayak has been studying the stable phases of electrons in dirty, impure metals. They found that in the weak-interaction, weak-disorder limit, such a system is always unstable to ferromagnetism.

Hong Wen Jiang was elected a Fellow of the American Physical Society for fundamental experimental studies of the ground-state phases of the two dimensional electron gas, including the first identification of the Hall metal state in a half-filled Landau level.

Gary Williams has predicted a new effect that may be observable in thin films of high-T_c superconductors near their transition temperature. A voltage difference should appear at the connection region between the thin film and the bulk superconductor, a manifestation of the critical Casimir force that has only been observed previously in superfluid helium films. This first calculation of the Casimir force in the superfluid phase was carried out using a vortex-loop renormalization theory developed over a number of years by Professor Williams.

Experimental Elementary Particles

The CDF (Collider Detector at Fermilab) group, led by **David Saltzberg** and **Jay Hauser,** welcomed a new faculty member **Rainer Wallny,** from the CERN laboratory. Professor Wallny is particularly interested in studying properties of the top quark particle that was discovered by CDF and its competitor experiment (D0) in 1995 and has immediately taken a position of great responsibility as head of silicon detector operations at Fermilab. During the past year, the CDF detector has steadily accumulated twice the data sample of the previous data run in which the top quark was discovered. Graduate student **David Goldstein** is measuring the production rate of top quarks, while **Matt Worcester,** another graduate student, is searching for signs of new physics that would produce events with two leptons (electrons or muons) having the same sign of electrical charge. Graduate student **Alon Attal** has been working to optimize the detection of electrons in the UCLA-built portion of the detector, in preparation for a search for multi-lepton events from Supersymmetry. Senior researcher **Michael Lindgrenis** is shouldering a heavy responsibility as Operations Manager for the entire CDF detector.



A diagram of production and decay of top quark particles produced at Fermilab. The discovery of these particles was announced by CDF in 1995. The top quarks are unstable and decay to other particles which are observed as tracks or energy deposits in the CDF detector. Fermilab is the only place in the world where these particles can be produced

Many members of the UCLA particle physics group have also been heavily involved in the construction of a powerful future CMS (Compact Muon Solenoid) detector that will be located at the CERN laboratory near Geneva, Switzerland, and will begin operation in 2006. The experiment aims to find the elusive Higgs particle, and to find particles that are predicted by theories of physics beyond the Standard Model, such as Supersymmetry. In particular, the UCLA effort is concentrated on the part of CMS that detects muon particles, a crucial signal for such particles. **Katsushi Arisaka's** team has assembled and tested almost all of their 72 large detectors using cosmic ray muon particles, and has shipped most of them to CERN for installation in CMS. **David Cline's** group at CERN receives the muon detectors and is involved in the installation of the detectors in CMS (thus far, 32 have been installed). **Jay Hauser's** team has built 515 large, high-speed electronics boards used for selecting and recording the particles that pass through the muon detectors. These electronics are tested and debugged with the aid of undergraduate students (supervised by postdoctoral researcher **Martin von der Mey**) in Knudsen Hall. Graduate student **Brian Mohr** went to CERN recently to demonstrate an excellent performance of the electronics in a test beam that closely simulated the CMS environment. For all the hardware that is built, there is a large amount of software that must be written, and this responsibility is shared by everyone. **Bob Cousins** and his team support much of the simulation and reconstruction code related to UCLA-built hardware in the official CMS software libraries. They have also been studying the performance of CMS to find a heavier analog of the Z boson, one of the carriers of the weak force.

The top of the disk of the muon detectors of the CMS experiment at CERN is at a height of 15 meters (49 feet). UCLA physicists built high-speed electronics located on each detector, and provided the final assembly and testing of these detecvtors

Peter Schlein and **Samim Erhan** are working on the CMS experiment at the Large-Hadron-Collider (LHC) at the CERN laboratory in Geneva, Switzerland. They are an integral part of the Data-Acquisition (DAQ) group of the experiment with major development and construction responsibilities. The DAQ system is a very large and complex computing system, which in real time, must look for 100 interesting proton-proton interactions per second out of the 40 million interactions that occur. Postdoctoral student **Peter Kreuzer** succeeded in improving, by a factor of 10 over the baseline rate in the DAQ Technical-Design-Report, the trigger efficiency for finding the rare decay of a Bs-meson into two muon particles. If this decay is found at a rate larger than predicted, it will mean that there is new physics beyond the Standard Model. The group is also doing

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

physics analysis of a possible Higgs boson discovery in Single-Pomeron-Exchange interactions. Partly based on their work in a prior experiment, UA8 at CERN, it is now known that there exists di-gluon clusters, called "Pomerons" in the sea of partons in a proton. The exchange of such a cluster in the interaction of two protons at LHC creates a situation where the Higgs can be produced in a very low-background environment in the central region of the CMS detector.

For **Bernard M.K. Nefkens** and colleagues, a significant accomplishment this year was the successful relocation of the famous Crystal Ball detector from Brookhaven, New York, to the University of Mainz, in Germany. This bulky but extremely fragile apparatus was elaborately packed and flown by a special Boeing 747 cargo jet from New York City to Frankfurt. It is now being readied for novel meson photoproduction and eta decay measurements. The project on cascade photoproduction at the Jefferson Laboratory in Virginia received an unexpected boost with the discovery of the first pentaquark, which is a heavy proton with one unit of "strangeness." Two more pentaquarks that have a unique signature are expected to exist; both are cascade particles, which are extra heavy protons with two units of strangeness. It appears that photoproduction is the only way to make them in the foreseeable future.

Theoretical Elementary Particles

Zvi Bern, with **Lance Dixon** from SLAC, and graduate students **Abilio De Freitas** and **Henry Wong,** recently computed important two quantum loop amplitudes for particle production at high energy particle colliders. These calculations are important contributions to a recent breakthrough for calculating higher order quantum effects. This breakthrough was used by Professor Bern and colleagues to improve a theoretical prediction useful for unraveling the mystery of electroweak symmetry breaking at the future Large Hadron Collider being built at CERN.

Graciela Gelmini and Alex Kusenko won a grant from NASA to conduct research on theoretical astrophysics of ultrahigh-energy neutrinos. This award will augment research being conducted from a U.S. Department of Energy grant.

John Cornwall is working on some important questions in quantum chromodynamics (QCD) on the theory of strong interactions of quarks, and on particle physics in the early universe. His QCD work involves the nature of topological charge in the center-vortex picture of QCD. It unexpectedly shows that topological charge is localized in fractions of the units (called instantons) long thought to be the only objects carrying topological charge. In early-universe physics, Professor Cornwall and **Alex Kusenko** are working on a new idea that involves the physics of creating matter-forming stars and planets.

Eric D'Hoker and **D.H. Phong** from Columbia University have made a recent breakthrough in higher quantum loop string theory scattering amplitudes. Superstring theory (in which the elementary constituents of matter are described as one-dimensional strings) automatically encompasses gravity, Yang-Mills theory, and Supersymmetry in a unified framework that is consistent with quantum mechanics. The starting point for string theory is a summation over fluctuating random surfaces. The number of handles of each surface corresponds to its order in the perturbative expansion in powers of the string coupling.

Tree and one-loop contributions were calculated long ago. Progress on higher loop contributions has been halted by profound conceptual inconsistencies encountered in the late 1980s. To address this problem, Professors D'Hoker and Phong developed a completely consistent formulation for superstring scattering amplitudes to two-loop order. The result takes on a simple form in terms of beautiful new modular objects.

Graceila Gelmini and **Alex Kusenko,** in collaboration with **Schmuel Nussinov** from Tel Aviv University, have found a way to identify dark matter candidates in underground detectors. With their students they have also explored possible solutions of the puzzle of high-energy cosmic rays and the ways to test them in experiment. Lastly, Professor Kusenko and a collaborator at Vanderbilt University invented a way to measure the neutrino-nucleon cross section at a center-of-mass energy 10^5 GeV well beyond the reach of any laboratory experiments. And they proposed a detection strategy that will make future space-based neutrino telescopes less vulnerable to the uncertainties in theoretical extrapolations of the Standard Model parameters.

Per Kraus and colleagues **Hirosi Ooguri** from Caltech and **Stephen Shenker** from Stanford University used methods from string theory and the AdS/CFT correspondence to gain a better understanding of the event horizons and singularities of black holes. They showed that string theory in the presence of a black hole could be formulated in one way that makes no reference to the region behind the horizon and in another way that provides a definite prescription for handling the usually divergent effects of the singularity.

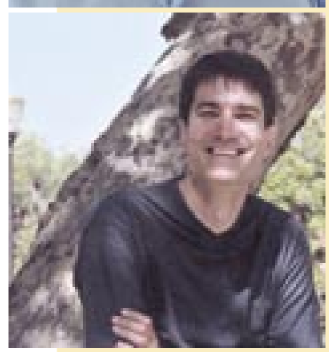
Terry Tomboulis has made an important advance in constructing a consistent description of quark confinement in terms of a soup of quantum objects called center vortices. These results have recently been substantiated through extensive, up-to-date computer simulations as well as through new analytical results. The physics of the confining QCD vacuum is now one of the main areas of activity in nonperturbative quantum field theory.

Plasma and Advanced Accelerators

George Morales and colleagues have conducted particle-in-cell (PIC)simulation of supersonic expansion through a pre-existing plasma that has identified major nonlinear effects. This explains observations in recent experiments at UCLA and predicts features measured by spacecraft in the auroral ionosphere. The processes identified are also of relevance to mass ejections from the solar surface, structures in the solar wind, and laser ablation of solid targets. The key process consists of the formation of a bipolar current system that shields the ballistic outflow of energetic electrons. The configuration triggers the transient formation of potential layers and carves deep density cavities that are long-lived. Additionally, a remarkable new phenomenon has recently been found in experiments performed at the Basic Plasma Science Facility (BAPSF) at UCLA. It consists of the first ever realization of an Alfven wave maser. This has been realized by creating a frequency selective Alfven wave resonator formed by applying a nonuniform magnetic field to a plasma region bounded between a cathode and a semi-transparent mesh anode. When a current threshold is exceeded, spontaneous amplification results in waves that undergo multiple bounces within the cavity. This yields an extremely monochromatic Alfven wave of

Warren Mori

George Morales



Steven Cowley

Phillip Pritchett

The National Science Foundation made a Major Research Instrumentation (MRI) award to members of the UCLA plasma research community to build a 256-node, 512-processor cluster. The project is under the direction of **Warren Mori** with co-investigators **Steven Cowley, Jean-Noel LeBoeuf, George Morales** and **Philip Pritchett.**

large amplitude that proceeds to propagate beyond the mesh anode into a large plasma column. This laboratory finding is analogous to maser mechanisms proposed to explain the behavior of low-frequency signals detected by spacecraft in near-earth plasmas.

__Jean-Noel Leboeuf__ was appointed to the Steering Committee of the Joint Institute for Fusion Theory with joint approval from the U.S. Department of Energy and the Japan Ministry of Education, Culture, Sports and Technology. It is through this program that U.S./Japan fusion research collaboration is organized.

The research of **Warren Mori** and colleagues has focused on the development of state-of-the-art simulation codes that run efficiently on parallel supercomputers. The group has used these codes to study problems in plasma-based accelerators, in inertial confinement fusion, and in colliding electron-positron plasmas. These topics are part of the rapidly emerging area of high-energy density physics, which has been called the X-games of modern physics. Major results include the development of a new simulation tool called QUICKPIC that has reduced the computational time for modeling plasma-based accelerators by a factor of 100 with no loss in accuracy. The group has used the codes OSIRIS and QUICKPIC to model the fulltime and space scales in three dimensions of ongoing experiments on the plasma wakefield accelerator. They have used these same codes to show that the energy of an existing linear collider, such as the Stanford Linear Accelerator, could be more than double in a plasma section only a few meters long. Lastly, they have used the codes to perform the most detailed simulations to date of the fast ignitor fusion concept. These studies have set the stage for a highly productive 2003–2004 year.

__Troy Carter__ won the 2002 American Physical Society Excellence in Plasma Physics Research Award and a Department of Energy Plasma Physics Junior Faculty Development Award.

This photograph shows the undulator -- a device composed of a series of magnet pairs with alternating poles (N S N S) -- for the Inverse Free Electron Laser (IFEL) experiment. This undulator, built by the Kurchatov Institute in Russia, is perhaps the most complex device of its kind as it features simultaneous tapering of the period and field strength. These features are necessary to assure a high accelerating gradient in the IFEL, which may some day be used for future colliders or even compact high energy accelerators.

The Particle Beam Physics Laboratory (PBPL) is one of the preeminent university beam and accelerator physics groups. Under the guidance of **Claudio Pellegrini** and **James Rosenzweig,** this large group engages in a wide range of activities in experimental and theoretical accelerator physics. These activities have a large, on-campus component, including two accelerator laboratories, and a significant off-campus component partially located at PBPL–collaborating institutions. They are focused on advanced acceleration research needed for high-energy physics applications, beam dynamics in high brightness systems, and radiation production through Thomson scattering Free Electron Lasers (FEL) and other novel sources. Diverse research topics are linked by common themes of fundamental interactions in beam physics—intense self-beam forces, beam-radiation, beam-plasma, and beam-boundary (transition, Cerenkov radiation) effects — and high brightness, picosecond beam creation and diagnostic techniques. This past year encompassed many significant milestones: the first ultra-high gradient plasma beatwave acceleration (PBWA) experiment was accomplished at the UCLA Neptune Laboratory, where 13 MeV injected electrons were accelerated to over 52 MeV in a several cm interaction using the world's most powerful CO2 laser; the IFEL advanced accelerator experiment was installed; powerful focusing magnets were designed and produced, which should help produce orders-of-magnitude greater X-ray fluxes at Thomson sources; the VISA II FEL experiment was started – a critical step in the progress toward an X-ray laser; and a number of key accelerator technologies were designed, including RF deflecting cavities to measure beam properties with femtosecond time resolution.

During the last year, **Reiner Stenzel** and colleagues have conducted research on magnetic reconnection and published six papers on the subject. Magnetic reconnection is a fundamental problem in space and laboratory plasma physics. This research explores a new parameter regime, electron magneto-hydro-dynamics, which is difficult to diagnose in space. The group has established a magnetic null point configuration and observed how it relaxes in space and time. This was accomplished by measuring the time-dependent field with a probe at thousands of points in space from highly repeatable experiments. The field changed topology and released its energy to the plasma electrons. The dissipation process was enhanced by self-generated turbulence. A new precision motion of the field configuration has been discovered. This research led to graduate student **Matthew Grisky's** doctoral thesis and a new, three-year research grant from the National Science Foundation. The work was presented in invited talks at national and international meetings.

William Newman and colleagues developed a biophysical-mathematical model for pediatric pilocytic brain tumors, completely unlike all existing models, which explains all of the clinical observations of the disease.

The UCLA Electric Tokamak—the largest device of its kind in the world (R = 5 m, a = 1m)—under the direction of **Robert Taylor,** achieved a 5-second tokamak shot in early 2003. The achieved long pulse operation allows detailed studies of high-beta regimes with a central energy confinement time of 1 second. The classical Troyon beta limit has been reached with $n_e(0) = 5\times10^{18}$ m^{-3} and $T_e(0) = 600$ eV. Real-time feedback on plasma positioning and plasma current played an important role in obtaining these long pulses. The goal of the project is to obtain stable unity beta plasmas ($\beta = P_{kinetic} / P_{magnetic}$) under fusion relevant conditions. The ultimate objective of the project is to realize plasma conditions that will be favorable to the development of economical fusion reactors with a few GW power production capacity, rivaling that of Hoover dam.

Alfred Wong and **Ralph F. Wuerker,** and the HIPAS ionospheric group, made successful creations of sky glows at 630 and 557 nm from atomic oxygen at 200 km altitudes in the polar ionosphere using the UCLA-HIPAS RF heater (70 MW ERP 2.85 MHz at Two Rivers, Alaska) along with similar and independent creations using the DOD-HAARP heater (Gakona, Alaska), this research has generated increased interest and support in ionospheric modification. The CW HAARP facility is being significantly increased—four times total power to 0.5 GW ERP. The group was asked by the Department of Defense to develop an inexpensive pulsed system that would match HAARP's peak power. Considerations of many possibilities led to the adoption of a radiating system hauntingly similar to the one used by Henrich Hertz in his original, (1886) demonstrations and verification of Maxwell's equations (1864).

Photograph of the 2.85 MHz Hertzian antenna at HIPAS, April 2003. This antenna is 104 meters long and 5 m above a ground plane made up of 2-1/2 inch diameter aluminum pipes. The antenna is supported by 4-inch diameter PVC drainpipe. It has a capacitance of 200 pF across its spark gap. The stairways are for central access. One of the antennas of the CW array at HIPAs is seen in the background

*The Smithsonian Institute has acknowledged that **Rubin Braunstein** first reported infrared light emitting diodes (LEDs) in 1955 in a scientific article for the journal, Physical Review. At the time Professor Braunstein was working at RCA laboratories in Princeton, New Jersey.*

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
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
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
Vice Chair For Astronomy and Astrophysics
Roger Ulrich
Charles A. Whitten
Gary A. Williams
Alfred Y. Wong
Chun Wa Wong
Edward Wright
Benjamin Zuckerman

Associate Professor
Huan Huang
James Larkin
Chetan Nayak
David Saltzberg

Assistant Professor
Troy Carter
Michael Gutperle
Brad Hansen
Per Kraus
Alexander Kusenko
Rainer Wallny
Giovanni Zocchi

Professor Emeritus
Lawrence Aller
(Deceased 3/16/03)
Hans E. Bommel
Rubin Braunstein
Nina Byers
Marvin Chester
Gilbert W. Clark
John M. Cornwall
Robert Finkelstein
Burton Fried
(Deceased 10/12/02)
Roy Haddock
George Igo
Leon Knopoff
Steven Moszkowski
Richard Norton
Mirek Plavec
David Saxon
UC President Emeritus
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

Assistant Researcher
Luca Bertello
Yasuo Fukui
Jean-Luc Gauvreau
Mark Gilmore
Mikhaeil Ignatenko
David Leneman
Chuang Ren
Glenn Rosenthal
Shoko Sakai
Frank Tsung
Stephen Vincena
Hanguo Wang

Sr. Lecturer SOE
Arthur Huffman

Education Highlights

Jean-Noel LeBouef captivates budding scientists at Celebra La Ciencia .

The Los Angeles Division of the Academic Senate of the University of California selected **Andrea Ghez** as a Faculty Research Lecturer.

2002-2003 Graduating Class

New Faculty

The department is pleased to announce the arrival of four new faculty members this academic year:

Troy Carter

Troy A. Carter comes to UCLA from Princeton University where he received his doctorate in plasma physics from the department of astrophysical sciences. Prior to his faculty appointment, he held a Department of Energy fusion energy sciences postdoctoral fellowship at UCLA. His research interests include turbulence and transport in plasmas, magnetic confinement fusion energy, and laboratory studies of phenomena relevant to space and astrophysical plasmas.

Bradley Hansen

After earning his doctorate in astronomy from the California Institute of Technology in Pasadena, **Bradley M.S. Hansen** worked as a junior researcher at the University of Toronto, then completed a Hubble Fellowship at Princeton University Observatory. His research interests are in three separate areas of theoretical astrophysics. His primary interest is in the origin and evolution of extrasolar planetary systems. Other interests are the evolution and appearance of white dwarf stars and their application as probes of galactic history; and the properties of neutron stars and pulsars and their roles in various astrophysical situations.

Michael Gutperle

Michael Gutperle earned his doctorate in theoretical physics from Cambridge University in the United Kingdom before coming to the United States for postdoctoral studies at Princeton, Harvard and Stanford universities. Presently, his field of research is nonsupersymmetric string theory and closed tachyon condensation. He plans to study time-dependent and cosmological solutions in string theory, a field still in its infancy, as well as fundamental aspects of string theory.

Rainer Wallny received his doctorate in high energy physics from the University of Heidelberg. He performed a precision inclusive structure function measurement with the H1 detector at HERA. In a subsequent combined QCD analysis using precision HERA and fixed target (charged) lepton-proton data, he extracted the gluon density and the strong coupling constant α_s simultaneously for the first time. He currently leads the silicon detector operations group of the CDF experiment at Fermilab, and plans to study high p_T phenomena involving top quark decays.

Rainer Wallny

A new undergraduate major in biophysics was approved at UCLA and will begin with the 2004–05 academic year. The program was developed in collaboration with the departments of chemistry and biochemistry, and molecular cell and developmental biology. Its purpose is to prepare a few students each year for top biophysics or physics graduate programs.

REU Physics and Astrophysics Program

With a grant from the National Science Foundation, the department launched a new summer program geared to junior and senior college students. Called Research Experience for Undergraduate Students or REU, the program enabled the department to offer its considerable resources to 12 students from across the country for 10 weeks of research and instruction—over 100 applied for this opportunity. Each student chose a physics or astronomy project and worked with a top scientist. The objective was to become involved in the totality of the research experience and participate in cutting-edge science. Projects were chose from the fields of plasma and beam physics, solid-state physics, astrophysics and high-energy physics. The grant provided travel expenses, accommodations and a stipend to each student. Program activities included introduction to other UCLA laboratories, inclusion in seminars and workshops conducted by faculty, technical writing instruction, GRE preparation, computer instruction, and a telescope camping trip to the California desert. **Francoise Queval** and **Walter Gekelman** wrote the grant and supervised the 10-week program.

Francoise Queval and **Walter Gekelman**

"Awesome! There are some cool things about science."

Steven, 8 years old

NSF-Sponsored Outreach to High Schools

Plasma researchers **Viktor Decyk, Frank Tsung, Manuel Urrutia, Walter Gekelman, Warren Mori** and **George Morales,** and graduate student **John Tonge** participated in a workshop organized by the National Science Foundation (NSF) at Loyola Marymount University during spring 2003. The workshop brought together physicists and high school teachers to explore outreach efforts for the benefit of local high school students. Professor Morales subsequently submitted a proposal to the NSF, which was funded. The grant provided funds that enabled one of the teachers, **Anna Fox,** from San Pedro High School, in San Pedro, California, to experience UCLA's research environment in plasma theory and computation during the summer.

Partnering with NSF to Aid Hispanic Students

Manuel Urrutia played a key role in establishing effective links that have resulted in sustainable outreach to Hispanic students. He and colleagues, **George J. Morales, Jean-Noel LeBouef**, and graduate student **Adrian Soldatenko** manned booths at community events this spring that showcased physical principles to young students and their families. Because of the program's success, a national effort funded by the National Science Foundation to improve the interest by Hispanics in math and science has enlisted the department as a partner, along with the California Science Center, the Jet Propulsion Laboratory, and other institutions in Los Angeles.

Manuel Urrutia bringing hands-on science to Latino families at the Celebra la Ciencia.

PSTI Summer Fellowships

The Plasma Science and Technology Institute (PSTI) awarded summer fellowship stipends to four outstanding members of the incoming graduate physics class that allowed the students to participate in research activities with a plasma group of their choice. Graduate student **Steven Hoover** successfully completed a computer simulation project under the guidance of **Jean-Noel Leboeuf** that will result in a scientific publication and a presentation at a forthcoming meeting of the Plasma Physics Division of the American Physical Society.

Mark Morris finished his fourth and final year as faculty coordinator for the general education cluster course that he created: Evolution of the Cosmos, the Earth and Life. This team-taught, one-year course for the new general education structure is one of 10 such courses now being offered across the campus. He is succeeded as faculty coordinator for this course by **James Larkin.**

Postdoctoral researchers in the UCLA CDF group have earned prestigious fellowships. ***Jane Nachtman*** *will be a Robert Wilson Fellow at Fermilab and* ***Benn Tannenbaum*** *will be a Congressional Science Fellow of the American Physical Society.*

NSF Center for Adaptive Optics Interns

James Larkin and colleagues hosted two summer interns as part of a program sponsored by the National Science Foundation Center for Adaptive Optics to assist underrepresented minorities from junior colleges. After the eight-week program of research and training, the students presented their results at a conference for minority researchers.

New Fellowships

UCLA is now participating in the Department of Energy Fusion Science Fellowship program effective 2003 through 2008. **Troy Carter** was primarily responsible for obtaining this valuable resource for students and will be the director.

UCLA's physics program has been awarded four U.S. Department of Education GAANN (Graduate Assistance in Areas of National Need) fellowships for graduate students in 2003, 2004 and 2005. The fellowships are prestigious and competitive, potentially as large as $21,500 per year, plus allowances for books and equipment.

PEERS Program

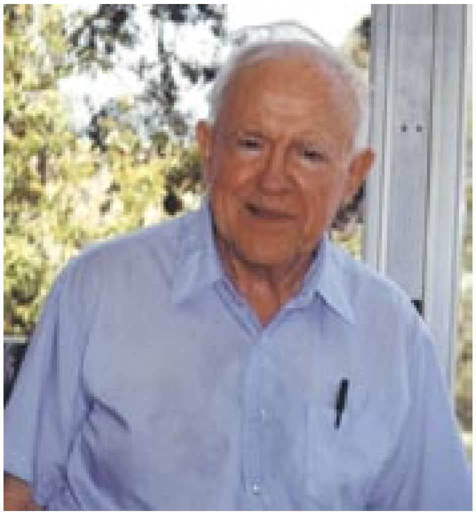
Charles Buchanan has been named director of PEERS (Program for Excellence in Education and Research in the Sciences) a newly created program in physical and life sciences to begin in Fall 2003. PEERS has two goals: 1) Provide exceptional collaborative learning workshops and tutoring in the introductory courses in the physical and life sciences for the general student body; and 2) for a cohort of approximately 30 students in the physical sciences, and a similar cohort in the life sciences, provide a program that enables the students to graduate from UCLA with an excellent understanding of their chosen fields. The program will be targeted to students whose successful entry into the sciences is inhibited by social, environmental, or academic barriers. It will provide access to collaborative learning workshops, counseling, informal contacts with faculty and graduate students, discussion of "hot" research areas, opportunities for meaningful research experiences, and the confidence to enter competitive professional or graduate programs, if they choose.

2003 Saxon Lecture

This year's lecturer was **John N. Bahcall,** Richard Black Professor of Natural Science at the Institute for Advanced Study, in Princeton, New Jersey. His areas of expertise include models of the Galaxy; dark matter, atomic and nuclear physics applied to astronomical systems; stellar evolution; and quasar emission and absorption lines. In collaboration with Raymond Davis Jr., he proposed in 1964 that neutrinos from the sun could be detected via a practical chlorine detector. In the subsequent three decades, he has refined theoretical predictions and interpretations of solar neutrino detectors. John Bahcall received his bachelor's degree in physics from the University of California, Berkeley, in 1956, and his doctorate from Harvard University in 1961. He was on the faculty of the California Institute of Technology and has been Professor of Natural Sciences at the Institute for Advanced Study, Princeton, since 1971. Throughout his career he has assembled an impressive list of awards and honors and contributed to his profession through service in a number of prestigious organizations.

In Memorium

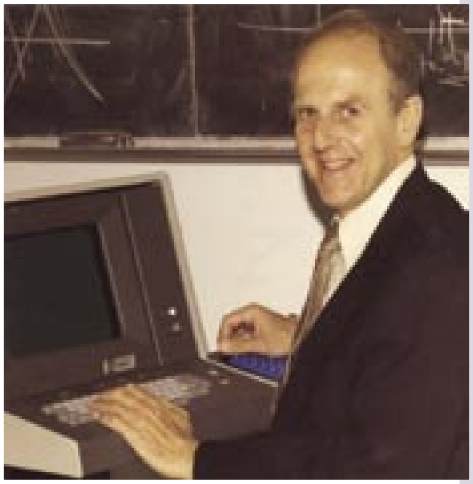
Lawrence H. Aller Helped Build the UCLA Astronomy Department



A high school dropout who became an astronomy professor, **Lawrence H. Aller,** was instrumental in developing UCLA's astronomy department and UCLA's doctoral program. He died at the age of 89 at his home in Malibu, on March 16, 2003. Born in Tacoma, Washington, Aller went to work as a gold miner and never finished high school. Later, he impressed a UC Berkley professor with his knowledge of astronomy and talked his way into the university earning a bachelor's degree there in 1936. He went on to Harvard, where he trained in atomic physics and astronomy, earning a master's degree and then a doctorate. After teaching at Indiana University and the University of Michigan, Aller came to UCLA in 1962. He chaired the department from 1963 to 1968. Among his many honors was his election to the American Academy of Arts and Sciences and the National Academy of Science. He contiued to teach into the mid-1990s although he retired a decade earlier .

Burton D. Fried was an International Figure in Plasma Physics and Fusion for 30 Years

Burton D. Fried made many seminal contributions to plasma physics and was a strong advocate of magnetic fusion as the ultimate energy source for mankind. At the age of 76, he died in Palm Desert, California, where he lived after retiring from UCLA in 1991. Born and raised in Chicago, Fried trained in theoretical particle physics under Gregor Wentzel and earned a doctorate from the University of Chicago. After completing postdoctoral training at the University of California Lawrence Laboratory, he was recruited by Simon Ramo in 1954 to work in a new company—TRW. He had a long and productive career at TRW, most noted for his collaboration with Glen Culler in developing an on-line computational platform that predated the modern PC-based software. Alfredo Baños Jr., recruited Fried to the UCLA Department of Physics in 1963, where he proceeded to assemble one of the world's leading plasma research groups. One of his lasting contributions was a book, co-authored in 1961, that was an analysis of a mathematical function known as the Z-function. It is a required element in graduate plasma courses taught throughout the world.



Graduates

Bachelor of Science Degrees Awarded

Astronomy

Pnina Barak
Yutaka Kikuchi
Quinn Konopacky
▪Departmental fellowship to pursue graduate studies in astrophysics at UCLA
Farisa Morale
Travis Purdy
Charlie Reyerson
Christel Smith
▪Departmental fellowship to pursue graduate studies in astrophysics at the University of California, San Diego

Physics

Hooman James Afshar
Michael Anderson
▪Departmental fellowship to pursue graduate studies in physics at the University of California, SanDiego
Justin Boseant
David Breuning
Justin Casalegno
Danny Chen
Justin Ducote
▪Departmental fellowship to pursue graduate studies in biomedical engineering at the University of California, Irvine
Colleen Kautner
▪ Full fellowship to pursue graduate studies in physics at the University of California, Berkeley
James Lincoln
Melissa Lincoln
▪Full fellowship to pursue graduate studies in applied physics at Stanford University
Robert Lobbia
▪Departmental fellowship to pursue graduate studies in aerospace engineering at the University of Michigan, Ann Arbor
Joseph Mansour
Adam Mendelshon
Rachel Millin
▪Departmental fellowship to pursue graduate studies in physics at the University of California, San Diego
Fred Motta
Thieu Nguyen
▪Departmental fellowship to pursue graduate studies in physics at the University of Utah, Salt Lake City
So Okumura
Omar Oloafe
Weichung Ooi
▪Departmental fellowship to pursue graduate studies in physics at UCLA
Richard Roberts
Jake Robinson
▪Full fellowship to pursue graduate studies in physics at Cornell University
Lucas Royland
Michael Schneider
▪Departmental fellowship to pursue studies in mechanical engineering at the University of California, Berkeley
Aniketa Shinde
Stephen Sun
▪Full fellowship to pursue graduate studies in physics at Stanford University
Christopher Ule
Michael Vagts
▪E. Lee Kinsey Senior Award (top in the class)
▪Full fellowship to pursue graduate studies in theoretical physics at the University of California, Berkeley
Gregory Walth
Chris Zeineh
▪Full fellowship to pursue graduate studies in aeronautics and astronautics at the Massachusetts Institute of Technology
Amber Young
▪Departmental fellowship to pursue graduate studies in physics at the University of California, Irvine
Alfred Yue

Doctoral Degrees Awarded

Astronomy

Christine Chen

Tiffany Glassman

▪Dissertation Year Fellowship 2002–2003

Amanda Mainzer

Condensed Matter Physics

Maria D'Orsogna

Erik Helgren

▪PAAL Outstanding Graduate Student Award 2001–2002 (Physics and Astronomy Alumni Alliance)

Heetae Kim

Hoang Nguyen

Rajesh Ojha

Kenji Tanaka

Sumanta Tewari

Elementary Particle Physics

Abiolio De Freitas

Gintaras Duda

▪Pauley Fellowship 1997

▪Outstanding Teaching Assistant Award 1998–1999

▪Waldo Lyon Fellowship 2001–2002

▪PAAL Outstanding Graduate Student Award 2002–2003 (Physics and Astronomy Alumni Alliance)

Li-Chung Ku

Plasma and Advanced Accelerator Physics

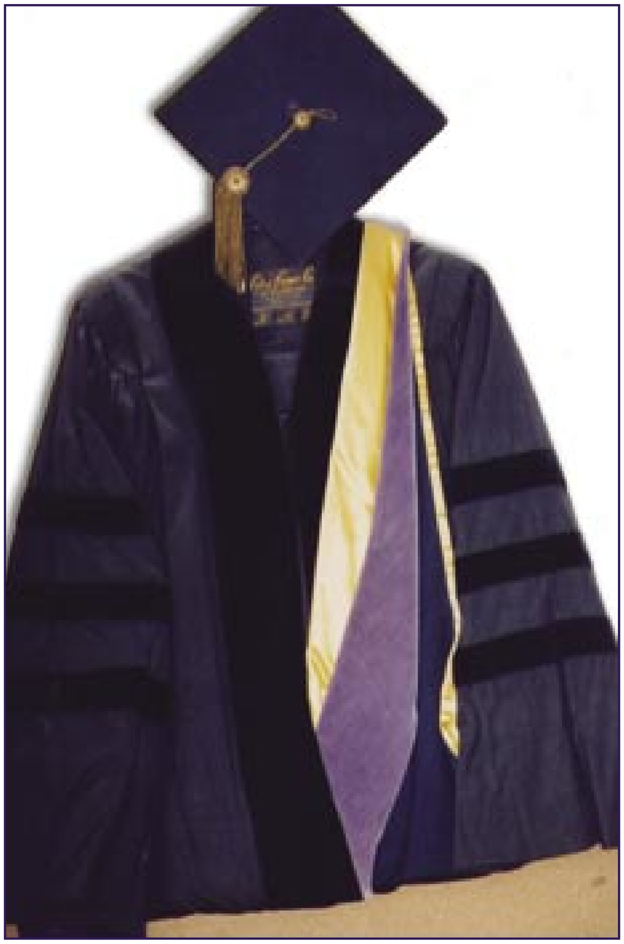
Jacqueline Pau

Michael Van Zeeland

▪Department of Energy (DOE) Magnetic Fusion Fellowship 1998–2001

▪Chancellor's Fellowship 1998–1999

▪Dissertation Year Fellowship 2002–2003



This ceremonial robe is believed to be worn by **Norman A. Watson** during his graduation ceremony in 1937. Dr Watson was the first graduate student to complete his research for a doctorate at Los Angeles.

$$\nabla \bullet \boldsymbol{D} = 4\pi\rho$$

$$\nabla \times \boldsymbol{E} = -\frac{1}{c}\frac{\partial \boldsymbol{B}}{\partial t}$$

$$\nabla \bullet \boldsymbol{B} = 0$$

$$\nabla \times \boldsymbol{H} = \frac{1}{c}\frac{\partial \boldsymbol{D}}{\partial t} + \frac{4\pi}{c}\boldsymbol{j}$$

and there was light

Maxwell's Equation (1864).