UCDAVIS

Newsletter

Number12 | A Newsletter for University of California, Davis, Physics Alumni | 2005

A Message from the Chair

A Message from the Chair

I am happy to report that we have had a great year. We now have 42 faculty members. Seven new faculty members who joined our department during 2004 are profiled in this issue of the newsletter: Patricia Boeshaar, John Conway, James Crutchfield, Robin Erbacher, Zachary Fisk, John Terning, and J. Anthony Tyson. The research fields of these new faculty members span a wide range of the subfields in the department. Tyson and Boeshaar specialize in observational cosmology and astrophysics. Fisk is a condensed matter experimentalist. Conway and Erbacher are both experimental high energy physicists while Terning is the first hire in our High Energy Frontier Theory Initiative (HEFTI). Crutchfield is a member of the Center for Computational Science and Engineering (CSE), directed by our own John Rundle. We are particularly proud that Fisk and Tyson are both members of the National Academy of Sciences.

We are conducting three additional searches for new faculty members this year, one assistant/associate level position for HEFTI, one assistant/associate level position in condensed matter theory, and one associate/full professor position in nanoscale biological physics, under the auspices of the interdisciplinary campus organized research unit, Nanomaterials in the Environment, Agriculture, and Technology (NEAT). If you know good people in these fields, please ask them to apply!

We did indeed develop our new academic plan in January 2004. This plan extends to 2008, the centennial year for UC**DAVIS.** We have articulated a vision for the department, including our plans for hiring faculty. We have also developed a space plan for utilization of the geology half of the building, effective 2008 when the Geology Department will move to the new Physical Science Expansion building. That building will also house additional classrooms for the Physics 7 discussion/laboratory sections.

Our student programs at both the undergraduate and graduate levels are in great demand. We now have 122 graduate students, after welcoming 38 new students in Fall 2004. We have about 150 undergraduate students, with 42 new freshmen and transfer students in Fall 2004. We have about 140 physics majors, with enrollment in upper division classes running at approximately 50 students per class. Clearly, the high quality of our recent faculty hires helps us to recruit good students at all levels. In addition, the economic downturn in nearby Silicon Valley has probably influenced some students to major in basic sciences like physics.

In 2003-04, we taught 3481 students in Physics 7, 2306 in Physics 9, and 179 in Physics 9H. For the last three years, we have also taught a large summer program consisting primarily of lower division courses (Physics 7ABC, Physics 9ABC, and Astronomy 10). This is part of the trend at the university to "make summer normal." Since these courses have been very popular with students, our instructional activities really continue year-round now, keeping our excellent staff very busy.

I myself was the local chair for the 64th Annual Physical Electronics Conference at UC Davis, held in Wellman Hall from June 20-23, 2004 (see newsletter article).

As you probably know, the State of California has had significant budget problems, and these have decreased our operating budgets and have caused increased student fees for both undergraduate and graduate students. Robert Dynes, the new President of the University of California, recently made a compact with Governor Arnold Schwarzenegger, which hopefully will reverse the downward budget trend for the university next year.

Finally, I would like to thank our wonderful staff for their support. Such a large department can only function successfully through their efforts. Tracy Lade joined us as our new department manager in January, 2004. We welcome the other staff members who joined the department in the last year: Onelia Yan in the Business Office, David Garrison in Student Services, David Hemer in the machine shop, Gabe Rosa and Anthony Shriver in computer support, and Matthew Smith in instructional support.

I apologize that our usual fall newsletter is late. I hope everyone had a Happy Holiday and best wishes for the New Year!

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Inside This Issue

Alumni Dinner Honors 50th Anniversary

by Professor John Jungerman

The Physics Department celebrated its 50th birthday in October 2003. It was a gala occasion, with 101attendees — alumni, faculty, postdocs, graduate students, and their spouses. Before dinner at the cocktail hour, alumni had an opportunity to share memories with each other and with the faculty. Also during this time poster sessions were held so that faculty could explain their latest research interests on a one-to-one basis.

We all enjoyed the catered dinner with plenty of good California wine. We took a moment after dinner to remember Bill True who had taught electromagnetic theory to many of the alumni present. Following were short presentations by the departmental research groups. The diversity of research at the forefront of physics and cosmology made one proud to think of the progress the department has made in the last fifty years. That was especially true for me, since when I came to the department in 1951, I was one of three faculty. Winston Ko, the new Dean of Letters and Science made a few encouraging remarks and the evening was concluded by our gracious Chair, Shirley Chiang. ❖

From left to right: Professor and Chair Shirley Chiang, alum Michael Hannon and spouse Gail Gong review photo boards of alumni during the wine and cheese poster session.

Professor Andreas Albrecht (on the left), presents the Cosmology Group's poster board.

Socializing before dinner are (from left to right), Beth Tooker with spouse alum Scott Tooker, graduate student Peter Marleau, along with Profs. Rajiv Singh and Mani Tripathi.

Welcome New Graduate Students

Emily Ashbaugh, UC San Diego
Andrew Baldwin, UC Davis
Justin Boss, University of Southern Maine
Scott Brisbin, UC Davis
Ami Choi, University of Chicago
Konstantin Chudnovskiy, UC Davis
Christopher Ellison, Pacific Lutheran University
Robert Forrest, UC San Diego
Cynthia Frei, UC Davis
Jamison Galloway, Notre Dame University
Owen Gross, Reed College
Can Gurses, Middle East Technical University and University of Pennsylvania
Nicholas Heller, UC San Diego
Cara Henson, UC Santa Barbara and CSU San Francisco
Donna Joliff, CSU Fresno
Rajesh Kommu, CSU San Jose and University of Alabama
Alexandra Kopecky, UC Santa Barbara
David Lagattuta, Carnegie Mellon University
Brian Lemaux, UC Santa Cruz
Orpheus Mall, UC Davis
Damien Martin, Victoria University
Nelson Page, UC Davis
Tommaso Pardini, University Cattolica
Peter Quinliven, Sonoma State University
David Reynolds, CSU San Luis Obispo and CSU Fresno
Hahnbidt Rhee, Iowa State University
David Ring, Iowa State University and UC Santa Barbara
Jamie Romnes, CSU San Luis Obispo
Michael Shaughnessy, Cornell University
Abrar Shaukat, UC Davis
Duk Shin, University of Washington and CSU San Jose
Ryan Snow, University of Utah
David Stancato, UC Davis
John Stilley, University of Texas at Austin
Yung-Shin Sun, National Taiwan University
Melinda Sweany, UC Davis
Christopher Varney, Northern Arizona University
Jerry Joe Vigil, Jr., Cornell University

Physics Club Officers 2003/2004

From left to right,
Faculty Advisor - Lecturer Randy Harris
Secretary - Etai Adam
President - David Cherney
Vice President - Matt Searle

Astronomy Club Officers 2003/2004

Faculty Advisors (from left to right)
Assistant Professor Christopher Fassnacht, Senior Lecturer Pat Boeshaar, Professor Emeritus Glen Erickson.
Astronomy Club Officers (from left to right)
Secretary - Christine Yang
Treasurer - Jessica Requeno
Event Coordinator - Rachel Peters
Co-President - Bryn Feldman
Co-President - Rachel Mann

Graduate Program

by Professor Steve Carlip

The Physics Department is bracing itself for the arrival of a record 38 new graduate students this fall. Thanks to a growing program and some extra money from the UCD administration — and, probably, the collapse of the local high tech industry — we had an unusually good pool of applicants this year. Several of our new students already have exceptional publication records — one is a coauthor of six published journal articles — and others are coming with extensive experimental experience.

While I'm sure we'll manage in the end, it's not completely clear how we're going to deal with such a large class. We are planning to bring in trailers to use as temporary offices, and we're rearranging furniture to make enough space in the classrooms where we teach first-year graduate courses. We're also scrambling to make sure we have enough money to support all of our students, with TAs, RAs, or fellowships. (Anyone have suggestions for outside funding?)

But despite an occasional grumble, we're looking forward to a strong and active incoming class, which fits in well with the growth of our department and the University.

Ph.D. Degrees Awarded

Alan Peel – *"Forecasting and Extracting Cosmological Information from Galaxy Cluster Peculiar Velocities"*
*Research Associate, University of Cambridge

Eric Minassian – *"Spacetime Singularities in Quantum Gravity"*
*Postdoctoral Researcher, University of Bern

Michelle Johannes – *"Computational Investigation of Magnetic Interactions: Combining First Principles and Model Approaches"*
*Research Associate, Naval Research Laboratory

Christopher Wren Carr – *"Experimental Studies of Laser Induced Breakdown in Transparent Dielectrics"*
*Principle Investigator, Lawrence Livermore National Laboratory

Norman Mannella – *"Spectroscopic and Structural Studies of Strongly Correlated Oxides"*
*Postdoctoral Scholar, Stanford University

Jeremy Gray – *"Optical Studies of Surfaces and Interfaces in UHV and Electrochemical Environments"*
*Postdoctoral Researcher, Lawrence Livermore National Laboratory

Ilke Arslan – *"Atomic Scale Characterization on Threading Dislocations in GaN"*
*Postdoctoral Research Associate, University of Cambridge, Materials Science and Metallurgy Department

Scott Locklin – *"Fourier Transform Spectroscopy in the Soft Xray Regime an Instrument for the Study of the Spectrum of Helium"*
*Beamline Scientist, Lawrence Berkeley National Laboratory

Yujun Chen – *"Quantum Liouville Theory and BTZ Black Hole Entropy"*
*Postdoctoral Scholar, Perimeter Institute of Theoretical Physics

Manuel Toharia – *"Phenomenology of the Mixed Higgs-Radion System in the Compact Randall-Sundrum Scenario"*
*Postdoctoral Researcher, University of Michigan-Ann Arbor

Trevor Willey – *"Characterization of Functionalized Self Assembled Monolayers and Surface Attached Interlocking Molecules Using Near Edge Xray Absorption Fine Structure Spectroscopy"*
*Postdoctoral Scholar, Lawrence Livermore National Laboratory

David Mobley – *"Models of Cooperative Dynamics from Biomolecules to Magnets"*
*Postdoctoral Scholar, University of California, San Francisco, Department of Pharmaceutical Chemistry

Master's Degrees Awarded

Austin Calder .... MS
Justin Church .... MS
Joseph Davies .... MS
Adam Getchell .... MS
Jason Giacomo .... MS
Alexander Graff .... MS
Brooke Haag .... MS
Alvin Laille .... MS
Randy Nelson .... MS
Justin Olamit .... MS
Daniel Osborn .... MS
Norman Paris .... MS
Naum Phleger .... MS
Stephenie Ritchey .... MS
Gregory Schofield .... MS

Master's Theses

Jason Knight - *"Spatially and Temporally Resolved Temperature and Density Measurements in a Laser Produced Plasma"*
*Associate Scientist III, Alameda Applied Sciences Corporation

Rebecca Duke - *"Utilization of a Low Temperature Pressure Cell for the Study of Heat Capacity in Thoriated UBe13"*

Bachelor's Degrees Awarded

Honors at graduation are awarded to students who have a grade point average in the top eight percent of the college. The Departmental Citation award is given to students in recognition of their excellent academic record and undergraduate accomplishments. The Saxon-Patten Prize in Physics is a monetary award given to a student who has achieved an excellent academic record and who shows interest and promise in continued work in physics and/or related physical sciences.

June 2003

Joshua Alexander .... BS
Melissa Eitzel .... BS
Departmental Citation
Saxon-Patten Prize
Nathan Farr .... BS
Departmental Citation
Saxon-Patten Prize
Jeffrey Garberson .... BS
Departmental Citation
Michael Granger .... BS
Elizabeth Groves .... BS
Degree in Applied Physics
Departmental Citation
Benjamin Haddad .... BA
Yukinori Ishitsuka .... BS
Derrick Kiley .... BS
John Kuehn .... BS
Degree in Applied Physics
Marc Lofing .... BS
James Macpherson .... BS
Degree in Applied Physics
Departmental Citation
Nelson Page .... BS
James Wheelwright .... BAS
Nicholas Whitman .... BS

September 2003

Peter McCloud .... BS

December 2003

Natalie Grancharov .... BS
Alexander Kitaigorodsky .... BS
Jeffrey Ludvik .... BS
Peter Tam .... BS

Degrees Awarded

March 2004

Stephen Baumgart .... BS
Departmental Citation
Saxon-Patten Prize

June 2004

Andrew Baldwin .... BS
Degree in Applied Physics
Departmental Citation
Saxon-Patten Prize
Michael Bell .... BS
Degree in Applied Physics
Scott Brisbin .... BS
Heather Brumbaugh .... BS
Samuel Lee Chandler .... BS
Konstantin Chudnovskiy .... BAS
David Crawford .... BS
Michael Eisenzopf .... BS
Brian Ellis .... BAS
Departmental Citation
Ari Erman .... BS
Cynthia Frei .... BS
Departmental Citation
Alfred Fuller .... BS
Degree in Applied Physics
Dhevan Gangadharan .... BS
Departmental Citation
Jungmee Kim .... BS
Janice Lam .... BS
Degree in Applied Physics
Cesar de Leon .... BS
Thomas Lincoln .... BS
Micah Lundberg .... BS
Departmental Citation
Orpheus Mall .... BS
Jennifer Meyer .... BS
Frederick Miguel .... BS
Anthony Murdock .... BAS
Jeremy Olson .... BS
Hanh My Pham .... BS
Departmental Citation
Timothy Pickett .... BS
Robert Pickle .... BS
Degree in Applied Physics
Jeffrey Plank .... BS
Degree in Applied Physics
Abrar Shaukat .... BS
Jaspinder Singh .... BS
Nicholas Squires .... BS
Departmental Citation
David Stancato .... BS
Departmental Citation
Saxon-Patten Prize
Melinda Sweany .... BS
Departmental Citation
Jeremy Thornton .... BS

Faculty News

Introducing...

Patricia Boeshaar

Ph.D. - The Ohio State University, 1976
Senior Lecturer with SOE in Astrophysics/ Physics
Professor Patricia Boeshaar joined the department in July 2003.

Surprisingly, we know far less about the distribution of the least massive red dwarf stars and Brown Dwarfs in our own galaxy than the distribution of galaxies and matter in the universe as a whole. The problem lies not in sheer numbers. Red dwarfs comprise the largest population of all types of stars. Rather, these objects are just extremely faint.

At 0.07 solar masses, near the hydrogen burning limit, tiny stars are a million times less luminous than the sun. Stars are defined as masses capable of energy generation by sustaining nuclear fusion. Below 0.07 solar masses, or about 60 Jupiter masses, objects are no longer capable of fusing hydrogen, but are capable of briefly fusing deuterium. To distinguish these objects from real stars, they are referred to as “smoldering” Brown Dwarfs (or BD’s). The brightest of such dim and relatively short-lived objects have been detected out to distances of only about 100 light years by recent large area CCD surveys. Unlike the comparatively young BD’s, the ages of red dwarfs can exceed the age of the galaxy. While some red dwarfs are being born today, others were formed throughout the galaxy’s history, back to the beginning. Distinctions can be made among the age groups based on the abundance of elements heavier than hydrogen and helium, since heavy elements must be forged in the nuclear furnaces of succeeding generations of stars. Stars in the halo of our galaxy were formed early, hence contain far fewer heavy elements.

My previous work involved separating the competing effects of temperature, surface gravity and abundance differences on the atomic line and molecular band strengths in cool stars. More recently I have utilized the data in deep CCD surveys to identify red dwarfs near the hydrogen burning limit in both the halo and younger disk populations, as well as BD candidates. The differential absorption produced by changing strengths of atomic and molecular species leads to a difference in the brightness of stars when observed in different colors or band-passes. Using three carefully chosen colors in the Deep Lens Survey (DLS), we have been able to successfully separate the age/abundance populations of extreme red dwarf stars and identify BD candidates. Though the fraction of sky covered is far less than other large area surveys such as the SLOAN survey, DLS compensates by going a factor of six farther — allowing us to examine in more detail than previously possible, the distribution of the lowest mass stars and BD’s with distance from the galactic plane. We should be able to place more stringent limits on the luminosity function (number

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of stars/luminosity/cubic parsec) for the oldest red dwarf halo population.

Though the halo extends more than 50,000 light years out in all directions from the center of the Milky Way, until very recently our knowledge of the lowest mass halo population has been confined to a handful of objects within 50 light years of the sun. Experimentally, masses for these objects are unknown since none discovered to date is a member of a binary system. Only in binary systems can dynamical mass estimates be made. Deep multi-color surveys provide an important venue for discovering these intrinsically faint objects at significant distances from the sun. Analysis of data obtained with the DLS will allow us to better constrain the distribution of the lowest mass stellar objects by population as well as BD's in our galaxy. This in turn will provide much needed information on the low mass stellar formation rate throughout the history of our galaxy. ❖

John Conway

Ph.D. - University of Chicago, 1987
Associate Professor, High Energy Experimental Physics
Professor John Conway joined the department in July 2004.

The field of high energy particle physics is poised for a major revolution. The discovery of the top quark at the Fermilab Tevatron in 1995 completed the picture of the three "generations" of elementary matter particles expected in the Standard Model. But these particles, the quarks and leptons, have masses which range over many orders of magnitude, begging for an answer to the central questions in the field today: What is the origin of the masses of the elementary particles? Why are there three generations? The matter particles we know about are all spin-1/2 fermions - can there be fundamental matter bosons as well?

The remaining missing ingredient of the Standard Model is the Higgs boson, the discovery of which could point the way to understanding the origin of mass itself. But there are good reasons to suspect that nature is more complex than having a single Higgs. If there is indeed a "supersymmetry" between bosons and fermions, then the Higgs sector will give rise to a number of physically observable particles that can be produced at the highest energy particle colliders.

In my research I have melded two main lines of attack: 1) developing and improving the methods for reconstructing tau leptons (the heaviest cousin of the electron) and 2) using these techniques to search for new particles like the Higgs and the supersymmetric partners of the known particles. I expect that this work will lead to great discoveries in the near future: all the new particles discovered in the past two decades have been found through methods that relied upon their decays to leptons. The tau is the heaviest lepton, and the Higgs prefers to decay to the most massive fermions that it can. I am looking for these tau decays of the Higgs at the Tevatron and am preparing to do so next at the Large Hadron Collider (LHC).

We have another several years of work with the data presently being collected at the Tevatron to make these discoveries, but in 2007 the LHC will begin operations with seven times more energy. It's a no-lose scenario: either we see new physics at the Tevatron or we almost certainly will at the LHC. If not, then the universe may be, in the words of Eddington, not only "more strange than we imagined but more strange than we possibly can imagine." And that itself would be a major discovery. ❖

James Crutchfield

Ph.D. - University of California, Santa Cruz, 1983
Professor, Computational Physics
Professor James Crutchfield joined the department in July 2004.

The primary focus of my research is on patterns—what they are, how nature produces them, and how we discover new ones. The origins of this interest date back to the 1970s, when the advent of powerful and interactive computers stimulated much work on nonlinear dynamics—deterministic chaos and bifurcations between distinct behaviors. This early work raised a number of questions on how the properties of nonlinear systems bear on the foundations of statistical mechanics, including the existence of nonequilibrium states and how one distinguishes "molecular chaos," required to derive macroscopic properties from microscopic dynamics, from the mechanisms of deterministic chaos.

Progress during the 1980s in analyzing increasingly more complex nonlinear systems eventually showed that these foundational questions were special cases of broader issues: How is it that nature spontaneously generates macroscopic order and structure? What mechanisms support the production of structure? How does nature balance randomness and order as structure emerges? And, perhaps most important of all, what do we mean by structure, pattern, order, and regularity? Can there be a theory that allows us to measure patterns as concretely and workably as we measure randomness using thermodynamic entropy and temperature?

This focus on patterns led to an even more central question: How do we (or any agent moving through the natural world) discover patterns in the first place? I call this pattern discovery to distinguish it from pattern recognition—familiar in engineering, where one designs systems with a built-in palette of templates, and familiar in the natural sciences, where one analyzes data in terms of an hypothesized representation, such as with Fourier transforms. In these cases, a pattern is recognized when data most closely matches one of the stored templates. Pattern recognition, however, begs the question of discovery: where do these representations come from in the first place?

Answering these questions led me to develop a generalization of statistical mechanics that explicitly defines structure and connects structure in natural systems to the issue of how they store and process information. In short, one asks, How does nature compute? The theory—unsurprisingly called computational mechanics—attempts to answer three quantitative questions: (i) how much historical information does a system store, (ii) where is that information stored; and (iii) how is it processed to produce future behavior? These computational properties complement the questions we typically ask in physics: How much energy is stored, in what form is it stored, and how is it transformed over time?

In its approach to patterns, computational mechanics uses the basic paradigm of statistical mechanics to synthesize nonlinear dynamics with information and computation theories. Over the last decade it has been used in a number domains, some well outside physics—in evolutionary biology and neuroscience, for example. My current research focuses on applying computational mechanics to structure in disordered materials, distributed coordination in collectives of intelligent agents, pre-biotic evolution, quantum computation, and the dynamics of learning itself. ❖

Robin Erbacher

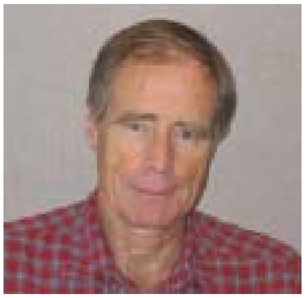
Ph.D. - Stanford University, 1998
Assistant Professor, High Energy Experimental Physics
Professor Robin Erbacher joined the department in July 2004.

My research has evolved from the study of the structure of the proton to using protons themselves as tools to study the fundamental constituents of matter. During the last decade, a series of fixed-target experiments at the Stanford Linear Accelerator Center (SLAC) helped bring to an end the "Spin Crisis," brought about by the lack of understanding of the basic spin structure of the nucleons. The naïve Quark-Parton Model had predicted that the proton spin was due to the sum of the individual spin quantum numbers of the constituent quarks. By probing polarized protons, neutrons, and deuterons with high-energy polarized electrons, we discovered that the net nucleon polarization is much more complicated. It results from not only the spin of valence up and down quarks, but also from the polarization of non-valence strange quarks in the nucleon, from the polarized gluon field, and from orbital angular momentum inside the nucleon.

Following my work at SLAC, I turned to the CDF experiment in Run 2 of the Tevatron, currently the highest energy accelerator in the world. My research has focused on elucidating the physics of the top quark. While the top quark had been discovered in the mid-90's at Fermilab, there were very few top quark events. Run 2 promises more than 20 times the data collected during the first phase, allowing us to compare top quark properties with what we expect from our Standard Model predictions.

With the top quarks currently in hand, we will soon gain insight as to whether or not top plays a special role in the Standard Model. After all, the top quark's extraordinarily heavy mass implies a coupling strength close to the electroweak energy scale. I am currently leader of the top Lepton Plus Jets group, the largest top physics analysis team on CDF. We are actively studying top anti-top pair production and decay properties, searching for the production of a single top quark, and studying the data for signs of new physics entering our top quark samples. My own analyses utilize new techniques to find top quarks, taking advantage of the unique kinematics in the extremely heavy top events. I have used these same techniques to search for a fourth generation top-like quark, which, if found, would take us to new territory beyond the Standard Model. ❖

Zachary Fisk



Ph.D. - University of California, San Diego, 1969
Professor, Condensed Matter Experimental Physics
Professor Zachary Fisk joined the department in January 2004.

A fundamental question in correlated electron physics is what determines the ground state: why is one material an antiferromagnet, a similar one a superconductor, yet another similar one a paramagnet? We have made only small progress on this problem. My research is focused on developing a description of correlated electron materials which will make clear the physics underlying the progression from magnetic to superconducting to normal metallic properties. This description looks

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at how the lattice modifies single ion properties by projecting out the experimentally determined temperature dependent single ion properties. A further goal of the program is to trace the physics of 4f intermetallic through 5f to 3d materials.

The research program involves physical studies of single crystal intermetallics, an important part of the investigations involving the search for new materials whose properties can be varied chemically or via pressure or magnetic field through a sequence of low temperature ground states. Magnetic, thermal and transport characterizations are carried out at low temperature, in applied magnetic fields, and also under applied pressure. ❖

John Terning

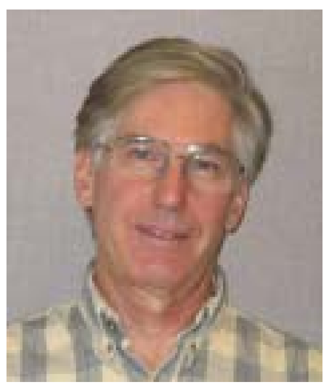
Ph.D. - University of Toronto, 1990
Associate Professor, High Energy Theory Physics
Professor John Terning joined the department in July 2004.

The mass of the electron is one of the two parameters (the other being the fine structure constant) that determine the structure of atoms and molecules. The mass of the *W* boson determines the rate of the weak nuclear interactions that power the stars. These two masses, and the masses of all the other elementary particles, arise through a mechanism called electroweak symmetry breaking.

In the Standard Model of particle physics this symmetry breaking relies on the existence of a Bose-Einstein condensate of hypothetical Higgs particles, so that the vacuum is an electroweak superconductor. This relatively simple set of ideas leads to a prediction of the ratio of *W* and *Z* masses that was confirmed by experiment, but particle theorists suspect that it cannot be the whole story. The main reason is that quantum corrections in this model are extremely sensitive to the highest possible energy scales; this has the effect of driving the mass of the Planck scale ~ 10^{19} GeV/c^2 the Higgs particle up toward the highest scale in the theory, but the Standard Model is inconsistent unless the Higgs mass is below the weak scale ~ 1 TeV/c^2.

My research focuses on exploring the possible extensions of the Standard Model that resolve this tension. The data from upcoming experiments will determine the origin of electroweak symmetry breaking. Particle physics is about to enter a new golden age when our theoretical flights of fancy will finally face up to cold hard data. ❖

J. Anthony Tyson



Ph.D. - University of Wisconsin, 1967
Professor, Cosmology
Professor J. Anthony Tyson joined the department in July 2003.

The universe is filled with a mysterious form of matter called dark matter. Since most of the mass in the universe is due to dark matter, it controls the dynamics and formation of massive structures like galaxies and clusters of galaxies. Such massive concentrations bend light from background galaxies, distorting their images in a systematic way. By applying charge-coupled-devices to astronomy, we discovered the population of distant "faint blue galaxies" and developed the technique of weak gravitational lensing. Weak lensing enables the remote detection and imaging of massive concentrations of dark matter. These tomographic images of dark matter, over a wide range of cosmic look-back times, probe the process of mass structure development.

Our "Deep Lens Survey" is the first comprehensive look at the universe of dark matter. In this survey we use two large ground-based telescopes to image ten billion distant galaxies. We follow up our detections of clusters of dark matter with the Chandra X-ray Observatory in order to learn more about the relation of ordinary matter to dark matter.

Even more mysterious is the recent acceleration of the expansion of the universe. What is its physical origin, "dark energy" or new gravitational physics? In either case the existence of dark energy suggests exciting new physics. Our group is probing dark energy by studying how dark matter bends light from background galaxies of very different redshift. When combined with cosmic microwave background data, such weak gravitational lens studies will sharply test theoretical models of the physics of dark energy. The Deep Lens Survey is the first such experimental probe.

I am an experimentalist interested in gravitational physics. My current research includes experimental cosmology: dark matter distribution, gravitational lens effects, cosmic shear, the nature of dark energy, pattern recognition, detection of transients in images, large database handling and processing, and new instrumentation and software for optical astronomy. Our cosmology group is focused on research in faint image reconstruction, faint transient optical bursts, investigations of dark matter distribution on cosmological scales, and the physical nature of dark energy. I direct a national effort to build a new kind of telescope/camera called the Large Synoptic Survey Telescope. With its large aperture and wide field of view, LSST will open new windows on the universe, from precision cosmology to studies of energetic explosions in new types of objects. ❖

Physics Professor Ling-Lie Chau receives the ASUCD Excellence in Education Award

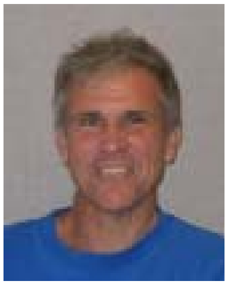
Professor Ling-Lie Chau received the ASUCD Excellence in Education Award on May 19, 2004. This award is given to faculty who display such characteristics as great subject knowledge and the ability to convey that to students, innovative teaching approaches, and effectiveness in student advising. Congratulations, Ling-Lie!

Daniel Cox, Recipient of the Guggenheim Fellowship

Daniel Cox, professor of physics, is among 185 artists, scholars and scientists selected from more than 3,200 applicants for the John Simon Guggenheim Memorial Foundation's 80th annual awards. Daniel Cox is currently spending a year on sabbatical at the Center for Theoretical Biological Physics at UC San Diego. Cox uses mathematical models to study the physics of biological problems such as the electronic properties of DNA and how metal ions interact with proteins. He is especially interested in prions — infectious proteins that are thought to cause "mad cow" disease in cattle, Creutzfeld-Jakob disease in humans and similar diseases in sheep, deer, mink and rodents. *Dateline,* April 16, 2004

John Rundle, 2004 American Physical Society Fellow

John Rundle, Interdisciplinary Professor of Physics, Civil & Environmental Engineering and Geology, and Director, Center for Computational Science and Engineering, has been elected a fellow of the American Physical Society. Professor Rundle was elected for innovative research and fundamental discoveries in the physics of driven nonlinear threshold systems, especially earthquake fault systems, revealed by computational simulations coupled with analysis using statistical physics.



Richard Scalettar, 2004 American Physical Society Fellow

Richard Scalettar, professor of physics, has been elected a fellow of the American Physical Society. Professor Scalettar was elected for pioneering contributions to the development and application of quantum Monte Carlo techniques to study phase transitions and collective states in strongly interacting systems.

64th Annual Physical Electronics Conference at UC Davis, June 20 - 23, 2004

by Professor Shirley Chiang

The 64th Annual Physical Electronics Conference was held at Wellman Hall on the University of California campus in Davis, California, June 20-23, 2004. Approximately 100 people attended, including 16 student competitors for the prestigious Nottingham Prize for best presentation based on doctoral research. This topical conference provides a forum for the dissemination and discussion of new research results on the physics and chemistry of surfaces and interfaces. The conference emphasized fundamental science in materials systems, including metals, semiconductors, insulators, and biomaterials. Two invited speakers gave very exciting talks: Professor Wilson Ho, UC Irvine, "Inelastic Electron Tunneling Implications for Nanoscience," and Professor Franz J. Himpsel, University of Wisconsin-Madison, "Atomic Chains, from Low-Dimensional Electrons to the Limits of Data Storage." The conference also included 43 contributed talks and 18 posters, with sessions on the following topics: Chemistry on Surfaces, Molecules on Surfaces, Low Energy Electron Microscopy of Metals and Semiconductors, Semiconductors Surfaces, Singles Particles and Quantum Wires, Novel Materials, and Novel Techniques for Studying Surfaces. On Tuesday night, the participants enjoyed a banquet aboard the *Spirit of Sacramento Riverboat* during a two-hour sunset cruise on the Sacramento River. At the banquet, the Nottingham Prize was awarded to Peter Wahl from the Max Planck Institute for Solid State Research, Stuttgart, Germany, for his talk on "Electron Correlation at Magnetic Impurities on Metal Surfaces." After the banquet, the prizewinner paid for drinks at Sophia's Thai Kitchen in downtown Davis for those who helped him celebrate. Overall, a very successful conference with outstanding science and excellent discussions among the participants! Special thanks to staff members Georgie Tolle and Jenni Mattheis for playing an important supporting role in all of the conference arrangements, including particularly abstract books and banquet arrangements, and to Tracey Brooks for assisting with the finances. ❖

UC Davis Research Experience for Undergraduate Research Program

by Professor Rena Zieve

Ten undergraduates from around the country attended the UC Davis Physics Department's first NSF-sponsored Research Experience for Undergraduates program. After a few introductory lectures on current areas of physics research, the students' ten weeks in Davis were primarily spent doing research supervised by one of ten faculty mentors. Projects included studying dark energy through statistical properties of galaxy clusters, controlling electrical transport in magnetic nanowires, and modeling earthquakes. Several field trips helped the students form a tight-knit social group as well. The most popular was an overnight stay at Professor Chiang's house near Lake Tahoe, followed closely by a tour of Lick Observatory. At weekly lunches, students discussed the progress of their work and other topics of interest such as graduate school admissions. The program concluded with a mini-conference of 20-minute research presentations by the students, open to the entire department. For one student, Evan Odabashian, now a junior at UC Davis after transferring from Butte Community College, the summer did not end there. Evan's advisors, Professors Scalettar and Pickett, arranged for Evan (and another UCD student, Daniel Hurt) to travel to Brazil and work briefly with Professor Thereza Paiva, a collaborator in Rio de Janeiro.

The UC Davis Physics Department first NSF - sponsored REU research group.

Cosmology Open House

by Professor Andreas Albrecht

In October 2003, hundreds of UC Davis undergraduates and other visitors paid a visit to the 5th floor of the Physics/Geology Building. The occasion was the "Cosmology Open House," which introduced members of the UC Davis community to the new cosmology group. Throughout the afternoon, visitors were treated to colorful posters and slide shows and short talks on hot research topics such as cosmic inflation, dark energy, the first galaxies and quasars and gravitational lensing. Over twenty-five members of the cosmology group (from undergraduate researchers to faculty) were available for informal discussions. At any moment there were numerous lively discussions underway, often focused on one of the many posters or white boards scrawled with diagrams and equations. Also on show was a wide range of new courses in cosmology to be offered at all academic levels.

To round out the open house, the physics department hosted a free public lecture by the celebrated cosmologist Michael S. Turner (Professor at the University of Chicago, member of the National Academy of Sciences and current Assistant Director for mathematical and physical sciences at the National Science Foundation). The talk, entitled "The Dark Side of the Universe," filled Roessler 66 with enthusiastic undergraduates and other visitors. The talk was such a success that most of the audience stayed on for a lengthy and intensive question period.

Between the open house and public lecture, the Physics Department inaugurated its attractive expanded 5th floor space, which includes space for the new cosmology group. After brief remarks from Provost Virginia Hinshaw, Professor Michael Turner, Dean Ko, and other dignitaries, the Provost and Professor Turner performed a ceremonial ribbon cutting for the new facility. Also, the cosmology faculty presented outgoing Dean Rock with a framed image of the latest cosmological data in appreciation of his role in building the cosmology group. Special thanks were also offered to Dean Ko, who was department chair for most of the cosmology buildup, Michael Turner who served as an external consultant and who, along with then chair (now Vice Chancellor for Research) Barry Klein helped launch the UC Davis cosmology initiative.

From left to right: Dean Winston Ko, Professor Michael Turner, Provost and Executive Vice Chancellor Virginia Hinshaw, and Dean Emeritus Peter Rock.

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