UCDAVIS

Physics Newsletter

Number 2 | A Newsletter for University of California, Davis, Physics Alumni | Spring 1996

From The Chair

Dear Friends of Physics:

The response to our first newsletter was very gratifying, with enthusiastic replies from our alumni from all over the country. I'm very pleased to hear of the successful and interesting careers that our graduates have undertaken, and we will spotlight some of them in subsequent newsletters. Please keep writing to us, and give us your suggestions for improving our couplings to our physics department community.

I thought that I would devote my comments in this newsletter to a brief discussion of some of the big issues that face our department, and indeed our discipline, within the context of the transformations that are under way in our country and our world.

The end of the Cold War has had a profound effect on nearly every aspect of our lives; many of these effects touch our educational and research enterprises at UC Davis. It has become clear that the Cold War environment not only supported an "entitlement" for deficit spending, but it was also a pillar upon which much of the growth of basic science was based.

The empire of federal support for science and technology has served us well during the past 50 years, but it is also clear that the phenomenal growth in science cannot continue at the previous rate, given the other societal needs and budgetary constraints that we are faced with. For example, in recent years, we in the United States have been graduating approximately 1400 Ph.D. physicists a year, compared to less than 500 in the 1950s and only a handful per year before World War II.

Of course, the growth was related to the increased technological content of our society, a major component of which was related to supporting the perceived "technology base" (basic research) that met the needs of the military. Right now there is a backlog of several thousand Ph.D. physicists in postdoctoral positions competing with our continued output of students for jobs in the various societal segments.

It appears that our Ph.D. graduates are getting well-placed with "good jobs," but there are many going into what might be considered "non-traditional" (non-university) areas of post-Ph.D. employment, where the education and acquired skills that accompany the physics Ph.D. are found to be valuable. These range from positions in "applied research" and software development in industry, Wall Street's financial market companies (they love our ability to "model", and our mathematical skills), and politics (more needed—right now there is one Ph.D. physicist in Congress; Vernon Ehlers, a congressman from Michigan, and somewhat more staff positions filled by physicists).

On top of this there are two other major changes that are emerging: keeping up with

continued on page 10...

Inside This Issue

Dedication
In Memory Of Ryan Edward Couch 1963-95

This issue of the *UC Davis Physics Newsletter* is dedicated to Ryan Edward Couch, who passed away in November 1995. Ryan received his B.S. in physics at UCD in 1986, and had been a graduate student in experimental physics at UCD since 1990. He is greatly missed by his friends and co-workers in the physics department.

The Ryan Couch Memorial Fund has been established in Ryan's honor to provide support funds for graduate students in physics to present their work at scientific conferences. Contributions to this memorial should be made payable to *The Ryan Couch Memorial Fund* and sent to the *Department of Physics, University of California, Davis, 95616, Attention: Teresa Overstreet.*

EARLY NUCLEAR PHYSICS RESEARCH AND THE FORMATION OF CROCKER NUCLEAR LABORATORY

by John Jungerman, professor emeritus

With Atomic Energy Commission (AEC) support, the Department of Physics embarked on the development of a precision beta ray spectrometer in 1956. Its purpose was to have a high resolution in order to measure internal conversion electron energies and from them to investigate nuclear energy levels. A solenoid about 10 feet long and 30 inches in diameter was constructed with correction coils carefully configured so that the magnetic field over the six-foot helical electron trajectories would be uniform to one part in ten thousand.

In order to assure uniformity of the field, the solenoid was constructed of copper ribbon 1-1/4 inches wide and twenty thousandths of an inch thick wound on edge. A series of some 40 coils each of 120 turns of copper ribbon and epoxy insulation were fabricated in the physics department, which was then located in a renovated garage, now the annex to the Department of Art. A commercial firm had failed to produce a satisfactory coil and in the process had used up our 10 percent extra length of copper ribbon. Through the skill of the physics department laboratory mechanician, Ralph Rothrock, a precision jig was constructed and physics faculty and staff successfully wound 50,000 feet of copper ribbon into coils with the requisite mechanical tolerance and electrical soundness.

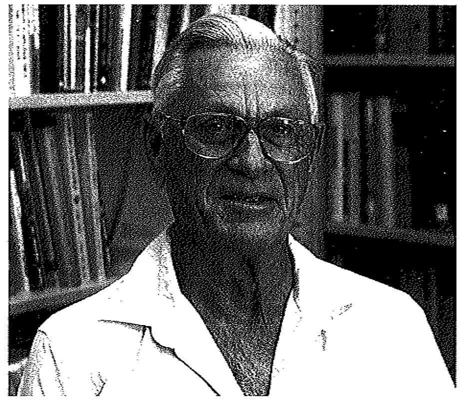
The newly discovered phenomenon of nuclear magnetic resonance was used to measure the magnetic field and to achieve its uniformity to 0.01 percent by tailoring the field with small additional coils. The beta ray spectrometer was an absolute instrument in that a measurement of the defining slit dimensions for the conversion electrons and the magnetic field determined the electron energy. To assure these characteristics, the earth's magnetic field within the instrument was carefully nullified to less than 1 percent of its initial value by means of 6th order correction coils that surrounded the spectrometer.

To increase the utility of the spectrometer we planned to introduce a beam from a Van de Graaf accelerator at its source point. We would then be able to precisely measure particle-induced gamma rays via their conversion electrons. I proposed this idea to Professor Earnest Lawrence, seeking his support. He thought about it for about 10 seconds and then stated, "Yes, a small cyclotron would be just fine for this purpose." Of course, a cyclotron with its stray magnetic field was not our first choice for an accelerator, but I decided that we would somehow shield the spectrometer from the stray field, and accepted his proposal immediately. Thus the 22-inch cyclotron was born. Professor Ed McMillan remarked at a later occasion that, "Lawrence thought you could do anything with a cyclotron."

The 22-inch was designed within the Department of Physics using the then-novel idea of an azimuthal change in the magnetic field giving "sector focusing" for axial stability of the beam. Neal Peek had a major part in designing the magnetic field shape, and Bill Knox designed the electrostatic deflector. We designed the cyclotron to be of variable energy and to produce protons up to 10 million volts with a similar energy for alpha particles. It began operating by 1964 and nuclear measurements began using its beams as a prelude to guiding them to the beta ray spectrometer. Newly arrived nuclear physicists Paul Brady and Jim Draper participated in this research. To avoid generating stray magnetic fields the cyclotron was housed within a steel box with one-inch thick walls.

Recognizing that the small cyclotron and spectrometer would not be sufficient for our proposed PhD program, I went to Professor Lawrence again in the late 1950s to obtain his support for a larger accelerator. As before, he thought only briefly and then suggested, "Why don't you take the 60-inch?" This was a world-famous machine that had been used to discover many radionuclides which are now commonly used, such as iodine-131, sodium-24 and phosphorus-32, as well as the elements technecium, astatine, neptunium and plutonium. It was to be replaced by a modern sector focusing cyclotron, the 88-inch, which is still operating at Lawrence Berkeley National Laboratory (LBNL). Naturally, I accepted his offer, and we subsequently sought support from other departments at UCD and generated a proposal for consideration by the AEC to move the 60-inch to Davis.

The AEC replied upon review that they would be interested in the proposal provided that we convert the 60-inch to a modern sector-focusing cyclotron that



would have increased beam intensity and variable energy. By this time (early 1960's) Professor Lawrence had unfortunately passed away. Yet I believe that his former approval of the transfer to Davis was probably still quite helpful in our securing support from the AEC. Not only that, in one of his last acts as chancellor of the Berkeley campus before becoming chairman of the AEC, Professor Glenn Seaborg authorized the use of a quarter of a million dollars to move the 60-inch magnet and associated equipment to Davis. These monies had been earned through charges for use of the 60-inch and were sequestered in a special fund.

Just after the 22-inch began successful nuclear experiments, the AEC program administrator asked on his yearly visit: "You have a choice. Do you want to continue running the 22-inch or the renovated 60-inch cyclotron"? This had an easy answer. The 22-inch quickly became surplus to our program and with it the dream of particle-gamma work with the spectrometer.

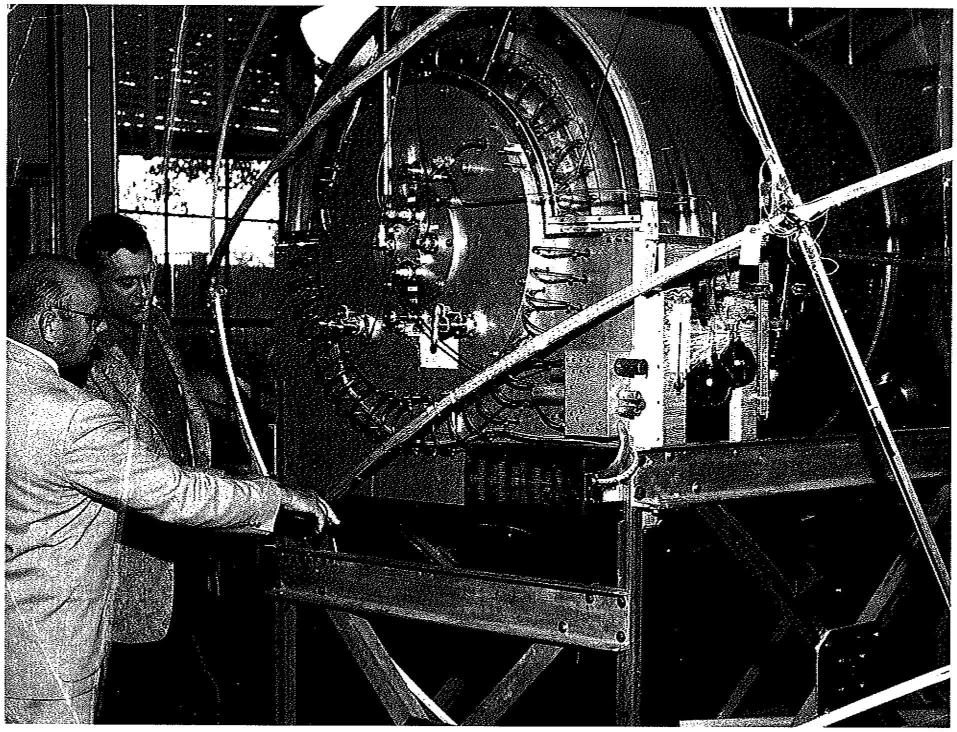
Most fortuitously, at this time Bill Knox happened to meet the Dean of Agriculture of the University of Chile at the annual faculty Steak Bake. Knox mentioned that we had a surplus cyclotron. Perhaps the physics department at the University of Chile might be interested? They were. Fortunately at that time there was a *convenio* or agreement between the University of California and the University of Chile financed by the Ford Foundation. Monies were found for transfer of the 22-inch to Chile. I happened to be there in 1992 and there was a celebration of 25 years since its first beam in 1967. The successful transfer of the 22-inch was accomplished with the aid of personnel from the Department of Physics here. Thus began a long association and collaboration in nuclear physics between the University of Chile and UCD.

The 22-inch cyclotron is still running. I remember cringing with some embarrassment as I watched the Chileans maintaining it with some difficulty within its one-inch steel encasement.

We began research in how best to modify the 60-inch cyclotron to produce a modern sector-focusing accelerator. The magnet of the 60-inch was really 72 inches tapered to 60 inches, so we began studies to produce the maximum energy with a 72-inch magnet. Extensive computer studies of orbit dynamics were conducted under the direction of Paul Brady. The design gave 100 MeV protons, which was very tempting as there were no sector-focusing cyclotrons running at that time with this much energy. In a conference at LBNL with Professor Ed McMillan, Dr. David Judd, chief of the theoretical division there, and Dr. Elmer Kelly, we were able to convince them of the soundness of our design in spite of possible non-linearities that might result, because we had used rather extreme values of some of the magnet parameters. At the conclusion of the meeting McMillan advised: "You will be remembered not for the extra energy you're trying to get, but rather for the research that will be done." After considering this admonishment and the risk of pitfalls with our own design, we decided to copy a known design of a 76-inch sector-focusing cyclotron then under construction at Oak Ridge National Laboratory.

The Oak Ridge accelerator has a vertical accelerating region, whereas the 60-inch magnet was designed for a more conventional horizontal one. We decided to re-engineer the Oak Ridge design for a horizontal vacuum tank — a non-trivial change. We also decided to incorporate an axial ion source, which had been designed for the new Berkeley 88-inch cyclotron. This latter source has a more precise location and permits acceleration of heavy ions or polarized ions much more readily than an ion source that must extend from the vacuum tank wall. So we bored an eight-inch hole in the center of the 60-inch magnet to accommodate the axial source and conducted a series of orbit calculations and magnetic measurements in the central region. This resulted in a central pole tip shape that gave the proper axial magnetic focusing at the beginning of a particle's acceleration. We also added a 2-inch annular steel ring so that the 72-inch magnet became 76 inches in diameter.

Brobeck and Associates helped with the re-engineering, but the physics department staff was responsible for assembling the parts and making it a functioning accelerator. In a further bureaucratic complexity, we decided to join with the Naval Research Laboratory in Washington, D.C., in building their cyclotron. It was also a copy of the ORNL design, but with a new magnet. The idea was to save money for the U.S. government by building two cyclotrons together instead of two independently. The collaboration had its benefits, but there were disadvantages. For example, the Navy procured the parts, but had no experience with accelerators. The Navy's submarine service accepted the new dee's for our cyclotron. They were woefully out of tolerance and needed to be extensively modified by the physics department shop.



Chancellor Emil Mrak and Professor John Jungerman at the beta ray specrometer (1961).

The cyclotron was completed in 27 months, which was a rather tight schedule. We produced our first beam just one week before a gala dedication in April 1966. This was a great relief to all and called for an improptu party late that evening right in the cyclotron bay. A few months earlier, the UCD administration decided that the new cyclotron should be a separate administrative unit to better reflect its utility to the entire campus. The name Crocker was kept in honor of Regent Crocker and to remind us of its 60-inch origin at the Crocker Radiation Laboratory on the Berkeley campus. So Crocker Nuclear Laboratory was created.

The 76-inch cyclotron project was a large one for our small physics department, but it did firmly establish our research in nuclear physics and greatly assisted our fledgling Ph.D. program. Neal Peek designed the shielding. It was arranged so that 30-ton blocks could be lifted off by the overhead crane to access the accelerator or beam lines. It has served the laboratory well. (Neal was also assistant director of CNL for several years.) The beam lines were carefully designed by Jim Draper. They have performed admirably and have provided the flexibility needed for CNL's diverse research program. Paul Brady procured the most advanced electronics to support the gathering and analysis of nuclear data. Bill True headed up the theoretical nuclear physics group to give us inspiration and guidance.

Chancellor Emil Mrak was a fervent supporter. I remember an occasion in Berkeley in 1964 when we were about to lose the $2.3 million from the AEC because the university administration had not yet signed the contract, which would have expired at the end of the fiscal year—now a weekend away. We were near a pay phone. He said: "Jungerman, do you have a dime?" I guess I did, because he phoned President Wellman and the project was saved. Mrak provided about a half million dollars of university funds to put up part of the building to house the cyclotron. When the NSF administrator came to the campus in response to our proposal, I remember walking over to the half-completed building with him and the chancellor. "How about NSF providing the other half?" he enquired. And they did. It's probably not done that way any more. ❖

'59

Roy E. Squires (M.A.) is senior engineering specialist at Aerojet Propulsion Plant in California.

'62

Sheldon M. Smith (M.A.) retired after 31 years of government service with NASA as a research scientist. He still maintains an office and reflectance lab at Ames Research Center as an Ames Associate.

'68

James Clark Solinsky (B.S.) earned his M.S. in physics in 1970 and his Ph.D. in physics in 1973 from the University of Minnesota. He is now a senior staff engineer for Cubic Defense Systems in San Diego.

'69

Robert T. Devine (Ph.D.) is a staff scientist at Los Alamos National Laboratory in Los Alamos, New Mexico.

Ray Warner (Ph.D.) is a program manager at Pacific Northwest National Laboratory, working on a radionuclide network that may be used to monitor compliance with the Comprehensive Test Ban Treaty.

'70

Mark DeSplinter (B.S.) was appointed mechanical and fluid systems engineering division head at Pearl Harbor Naval Shipyard in November 1995.

Michael T. Gillin (Ph.D.) is associate professor of radiation oncology at the Medical College of Wisconsin in Wauwatosa.

Richard Knowles (B.S.) is assistant vice president, application systems at Federal Home Loan Bank in San Francisco.

'71

Edward W. Bradley (B.S.) is currently a senior scientist at SAIC in Sacramento.

Noel D. Cary (B.S.) went on to earn an M.A. in astronomy in 1973 from the University of Virginia. Noel worked for NASA subcontractors in the 1970s (including work on the Jupiter Galileo mission at NASA-Ames). He got interested in the history of science, and then in history more generally; he went back to school (UC Berkeley) and got his Ph.D. in history in 1988. Noel now teaches modern European history, German history, and history of science as an associate professor of history at Holy Cross College in Worchester, Massachusettes. He has done extensive research in 20th century German history. Harvard is publishing his book, *The Path to Christian Democracy,* this spring. He is currently doing research on "The Munich Olympics of 1972 and German National Identity" with the help of NEH and other stipends.

'72

Chris Crawford (B.S.) is self-employed. He has been designing computer games for 16 years. He has published 14 computer games and four books. Chris also edits a technical journal, and he founded the professional conference for computer game designers. Currently, he is working on interactive storytelling.

After 15 years of practicing diagnostic radiology in Sacramento, in August 1994 **Jeffrey J. Heffernon** (B.S.) moved to frosty Northern Wisconsin where he is with the Marshfield Clinic serving as director of radiology at the Howard Young Medical Center in Woodruff, Wisconsin.

'74

Paul Grant (M.A.) is a programmer/ analyst at the Department of Information Technology at UC Davis.

'75

John Rominger (M.A.) is an engineering group leader at Litton Electron Devices in San Carlos.

(Raymond) Roger Shile (M.A.) is a research engineer at Stanford University.

'76

Gordon W. Wolfe (Ph.D.) worked at the UCD Crocker Lab with Professor Tom Cahill's Air Quality Measurement Group before graduating in 1976. After graduation, he was an assistant professor of physics at the University of Mississippi for four years. When the dynamitron accelerator was shut down, he worked in New Orleans studying pollution transport in the Mississippi River. For the past eight years, Gordon has been a senior principal scientist at the Boeing Company in Seattle, Washington.

'77

Richard (Dick) J. McDonald (Ph.D.) is presently working at Lawrence Berkeley National Laboratory doing low-background gamma-ray spectroscopy, following 10 years as a user liaison scientist at LBNL accelerators. His main job, however, seems to be raising two sons, ages 3 and 6. To keep sane, he has taken up gymnastics, and says, "It is a crazy sport for an old man, but sure is fun!" He still does some running as well.

'78

Thomas J. Kane (B.S.) earned his Ph.D. in electrical engineering in 1986 from Stanford. He is now the R&D group leader at the Lightwave Electronics Corporation in Mountain View.

'79

Khalijah Mohd. Salleh (Ph.D.) has been working on problems of physics learning, particularly with respect to misconception and understanding of physics ideas. She has also been actively involved in promoting the socio-cultural dimension of science and the need to enhance science literacy among members of the public. She was awarded professorship at University Kebangsaan Malaysia in July 1995 for her work on physics education/science and society.

Pete Smietana (Ph.D.) is project leader for Molecular Dynamics in Sunnyvale

T. S. (Mani) Subramanian (Ph.D.) is a medical physicist at Consultant in Concord.

'80

Arthur B. Edmonds, Jr. (Candidate in Philosophy) is principal at the Second Star Group in Piedmont.

Michael Lee (A.B.) is patent counsel at FMC Corporation in Santa Clara.

Marvin Ross (Ph.D) is department Manager at Hughes Aircraft Company in Los Angeles.

Donald Craig Wheeler (B.S.) continued on to earn his M.D. in 1986 from University of Southern California, and he is now a staff physician–radiology at Kern Radiology Medical Group in California.

'83

LuAnne Thompson (B.S.) completed her education at MIT with a Ph.D. in oceanography. She is currently an assistant professor at the School of Oceanography, University of Washington in Seattle.

'84

Thomas S. Bakes (B.S.) is a systems engineer with Argonne National Laboratory/University of Chicago. He is currently involved with separating fission products from actinide species on spent Experimental Breeder Reactor-II (EBR-II) fuel.

Zafer Durusoy (Ph.D.) is an associate professor of physics at the Hacettepe University in Turkey.

'85

Jim Brennan (M.S.) is an instructor at Treasure Valley Community College in Ontario, Oregon.

T. Kevin Cross (B.S.) is a sales engineer for Honeywell in Miramar, Florida.

Eugene L. Dines (Ph.D.) is currently working as a senior design engineer for Irvine Sensors Corporation, an advanced electronics/aerospace company in Costa Mesa.

James M. Dorman (M.A.) was recently named director of the McClellan Central Laboratory located at McClellan Air Force Base in Sacramento. The laboratory employs scientists, engineers, and technicians utilizing a variety of analytical methods in support of national treaty monitoring programs.

Edward Jenvey (B.S.) is an analyst–financial engineering at Nikho Research Center in Los Altos.

'86

Christopher M. Foster (B.S.) went on to earn a Ph.D. in physics from University of California, Santa Barbara, in 1980. He is currently a research scientist at Argonne National Laboratory in Illinois.

'87

L. Michael Hayden (Ph.D.) is associate professor of physics at the University of Maryland, Baltimore County.

Jack Miller (Ph.D.) is a staff scientist at Lawrence Berkeley Laboratory in Berkeley.

'88

Douglas Charles Rodenberger (B.S.) earned a Ph.D. in physics from the University of Pennsylvania in 1992. He currently works as a geophysicist at Shell Oil Company in New Orleans, Louisiana.

'89

Randal Hans (B.S.) went on to earn his M.S. in physics from Yale in 1990, and is expecting his Ph.D. in physics from Yale in 1996. In January, he began his position as postdoctoral research associate in physics at the University of Illinois at Urbana-Champaign.

Jeff Lewis (Ph.D.) is a lecturer in physics at California State University, Bakersfield.

'91

A. David Grasseschi (B.S.) is a field service technician for Technical Safety Services in Richmond.

'92

Marc T. Baniak (B.S.) is a geophysical technician at Western Geophysical in Houston, Texas.

Thomas Berger (B.S.) is a research assistant at the University of California, San Diego.

Nancy Jia (Ph.D.) has accepted a position with Xerox in New York.

Greg Spooner (Ph.D.) is a senior development engineer at Coherent in Palo Alto.

'93

David Barnes (Ph.D.) is the director of the College of Engineering micro-fabrication lab at UC Davis.

Heather Logan (B.S.) is a graduate student in physics at the University of California, Santa Cruz.

Kyle Noderer (B.S.) is a postgraduate researcher at the Agricultural Health & Safety Center, UC Davis. ❖

Post-graduate Life

by Victor Da Costa, Tom Fiske, Russel Martin, and Duane Siemens

Although the UCD physics department has been around for quite a while, one would not expect by chance that four graduates would end up in the same laboratory outside of Davis. But the "Old Boys Network" can work that way, and four former denizens of the department basement are all in one group at the Xerox Palo Alto Research Center (PARC).

Victor Da Costa (Ph.D. '88), Tom Fiske (Ph.D. '90), Russel Martin (Ph.D. '81), and Duane Siemens (Ph.D. '92) all work in the Advanced Systems Group of PARC's Electronics and Imaging Laboratory (EIL). The lab, EIL, develops advanced liquid crystal displays and amorphous silicon based image sensors. The Advanced Systems group does design, analysis, testing, and development of the newest of the displays and sensors that EIL produces. EIL itself is in the process of evolving into a separate business entity within Xerox to capitalize on its position in the rapidly growing business of displays and image sensors.

How we all ended up with offices in the same building is a matter of the strengths of UCD Physics and the connections that remain to ones' old department. Russel Martin started work for Xerox in '81 at the Microelectronics Center in El Segundo, California, and, although he did recruiting for Xerox, he never was able to hire someone from the physics department. In '84 he transferred to PARC and, while working with the Versatec Division of Xerox, he was able to bring Victor Da Costa to the attention of the R & D manager of Versatec. Victor was hired by Versatec and about two years later he transferred to PARC. When someone was needed to do optical characterization in their group, Victor recommended Tom Fiske for the position and Tom joined the ranks. Then finally, earlier this year, after it was pointed out to their manager that the group had done pretty well with UCD physicists, Duane Siemens (who was strongly recommended by both Tom and Victor) filled another vacancy.

It seems that experimental solid state physics makes a good background for the electronics industry. The four of them have been able to work on a wide variety of tasks in R & D at Xerox. Most of Russel's work over the years has been device physics and microelectronics. He worked in high voltage integrated circuits both in crystal and amorphous silicon. He developed fine line CMOS technology, working on N and PMOS transistor design. Now his efforts are mostly in system electronics for active matrix liquid crystal displays (AMLCDs). In the middle of all of this, he took a one year sabbatical at NASA Ames and studied human vision. While at Ames he wrote computer models of the human perception of color matrix displays. He was recently promoted to principal scientist.

Victor started his career in industry working for a division of Xerox developing high voltage amorphous silicon (a-Si) circuits for applications in wide format printers. Victor designed the first a-Si print array that Xerox introduced in a printer product in 1992. In 1991, Victor transferred to PARC where he designed a polysilicon projection display. He has also written numerous software applications for debugging and demonstrating Xerox flat panel display technology. Victor is now concentrating on system issues related to high resolution AMLCDs. He has designed a VLSI controller chip for use in driving a wide range of AMLCD architectures, and he has recently developed a high speed digital graphics controller for PCI based computers. To quote Victor, "The great thing about a physics

continued on page 6...

Post-graduate Life *(continued from page 5)*

background in this industry is that they'll let you try anything, at least once."

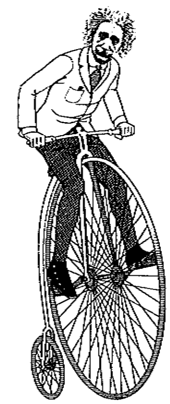
Tom's work has focused on optical characterization of components of liquid crystal displays. He has built up expertise in color science, liquid crystal display optical performance, and backlight design. His laboratory can characterize the angular dependence, colorimetric performance, uniformity, and temporal response of liquid crystal displays. Tom has also been active in organizing the yearly International Symposium of the Society for Information Display.

Duane started working at Xerox this spring after a few years of college level teaching following his graduation. Some of the areas he has been involved in so far include microelectronic device testing, liquid crystal display prototype debugging, and a-Si thin film transistor pixel design. Despite the lack of experience in these specific areas, by reading papers in the literature, talking to (bugging) his more experienced colleagues, and mainly by jumping in and getting involved in projects, he has been able to quickly contribute in these new areas.

Apparently there have been two features that might explain the success of UCD grads in this group at PARC. The first is that physics is a good background for a wide variety of tasks in the electronics industry. It provides the basis to understand and quickly learn a variety of disciplines. Second, in the solid state group grad students typically have to develop much of the apparatus and techniques themselves. This is different from the very large schools where typically students take over a well-developed lab from an older graduate student and apply established techniques and equipment to a new problem or material.

There are many positives about working in the semiconductor industry. There is opportunity to work with top notch people from a wide variety of backgrounds rather than just "physics people." The group agrees that work in this industry has more clearly defined goals than in basic research, which is desirable for this group, but may not be for everybody. Also, the projects are much more team oriented than we experienced in graduate school.

For physics graduate students interested in a career in the semiconductor industry, the group agrees that the student should take heart that the long hours spent in the solid state lab trying to debug what is going wrong with a thesis experiment is considered to be very valuable experience in this industry. Other recommendations, beyond the major solid state subjects, are experience in circuit and software design and familiarity with multiple computer operating systems. It is also a good idea to keep abreast of technology trends in the semiconductor industry. As far as getting a job in the industry, connections work the best—just look what they have done for us! ❖



Graduate Program

Graduate Recruitment

by Ling-Lie Chau, professor and chair of the Recruitment Committee

With the number of graduate student applications on the decline nationwide, the physics department has initiated steps to attract outstanding applicants to the Davis campus. The department and the campus have a lot to offer students, and we want to get the word out. We started by creating a home page on the World Wide Web (http://www.physics.ucdavis.edu), updating our recruitment posters, and initiating new outreach activities.

In November 1995, the department held it's first Seniors' Open House Conference. Outstanding undergraduate seniors, master's students, and faculty advisers from Northern California state universities and other universities within the local area were invited to participate in this day-long event. Most participants arrived the night prior to the event and spent the evening enjoying the local area hot spots. The next day, the conference began with faculty presentations about current research projects in their areas of expertise. After lunch, the participants had a chance to meet with current graduate students and discuss research being performed in the department. The day concluded with tours through the Crocker Nuclear Laboratory and the physics department laboratories.

During the year, faculty members routinely visit individual universities and colleges to present information about the department's graduate program. To aid in these presentations, the department's Recruitment Committee has compiled recruitment kits, which are now nearing completion. The kits contain transparencies with information about the campus and the department, and student-faculty research activities. Faculty members also attend various national recruitment activities, such as graduate information fairs and National Physical Science Consortium meetings.

This year's recruitment activities will be wrapped up with a weekend open house for applicants who are offered admission to our graduate program for fall 1996. Events planned include an informal evening gathering, presentations by faculty and current graduate students on research activities, tours of the laboratories and campus, and will conclude with a social hour and dinner.

As you can see, recruiting physics students is a major undertaking that is the true lifeblood of our department. We welcome our alumni to help in these efforts! ❖

UCD Washington Center Internship

by Bennett Corrado, graduate student

This past summer, I had an internship through the UC Davis Washington Center, a campus program that provides the opportunity for Davis students to intern in the nation's capital. My summer was spent working with the American Physical Society (APS) and the Office of Science and Technology Policy (OSTP), monitoring and analyzing congressional legislation regarding basic research funding and policy for the physical sciences. The OSTP is run by the president's science advisor and provides expert advice to the president in all areas of science and technology. The APS maintains a Washington office to monitor congressional legislation regarding basic research funding and policy for the physical sciences.

My time was spent monitoring the progress and changes in several appropriations bills and following legislation proposing the elimination of the Department of Commerce. Information about appropriations bills came from a variety of sources. I attended committee mark-ups and watched hours of floor debate on C-SPAN. I also spent time reading the actual bills and associated reports to determine how much money was to be allocated to physics research.

My project monitoring proposals to dismantle the Department of Commerce was of interest to the APS because housed in the DoC is the National Institute for Standards and Technology (NIST). NIST was established in 1901 as the National Bureau of Standards (NBS) to satisfy and uphold constitutional requirements concerning weights and measures. From those beginnings, NIST has evolved into the world's premier center for metrology: the science of measurement. In 1988, NBS became NIST and expanded its functions to include the Manufacturers Extension Program (MEP) and the Advanced Technology Program (ATP), both designed to aid in technology transfer from government labs to the private sector and to assist small businesses that cannot afford their own research and development programs.

ATP was dramatically expanded in the Clinton administration to the point where it constituted 60 percent of the president's 1996 budget request for NIST. However, the Republicans are in charge of this Congress and they are committed to reducing federal spending. As part of their plan to reduce the federal government, Republicans have their eye on eliminating four departments: Energy, Housing, Education, and Commerce. In this Congress, a bill introduced by Senator Spencer Abraham (R-Mich.) and co-sponsored by Senators Dole and Gramm (S. 929) proposes the elimination of the Department of Commerce. A similar bill introduced in the House by Representative Dick Chrysler (R-Mich.) was withdrawn, but the House Science Committee still held hearings to discuss the proposal. These bills include the disestablishment of the National Institute for Standards and Technology (NIST). The Abraham bill would transfer the "weights and measures" responsibility to the National Science Foundation and would sell the NIST laboratories. It is the sale of the laboratories that concerns the APS.

Worried that the baby would be thrown out with the bath water, the APS launched a grassroots information campaign. With information from NIST, I worked with the people in the Washington office to contact previous users of the NIST facilities from the states and districts of the members of the committees holding hearings on the bills. My part consisted of correlating the long list of users with the key congressmembers, writing a fact sheet to be faxed to those contacted, and making contact with the identified users. After the information campaign was accomplished, I attended every House and Senate hearing on the matter. I also attended briefings and updates at the Department of Commerce and at OSTP. Afterwards I would brief the people at the APS Washington office and participate in the evaluation of events.

Overall, I think this was a marvelous opportunity. The people I worked with were interested both in educating me in how the federal government works, and in my opinions and observations as I was learning. Any physics graduate student who thinks he or she might be interested in national science policy should spend a few weeks interning at the APS Washington office. Since the office is run by physicists, the working atmosphere will be different from other Washington offices, but the student is sure to be in the thick of things. ❖

<u>Editor's Note</u>: UC Davis physics graduate student Ron Sobey will be interning at the UC Davis Washington Center during the summer of 1996.

1995/96 Fall Gathering

by Xiangdong Zhu, associate professor

Fall Gathering is one of the three annual social events of the physics department. Organized by the Social Committee, the Fall Gathering offers the opportunity for new graduate students to be introduced and welcomed to the department, for all graduate students and their families to meet and socialize with members of the faculty and their families, and for the departmental chairperson to bring everyone up to date on the state of the department. Usually, the gathering takes place at one of the two most charming locations on campus, Putah Creek Lodge or Recreation Pool Lodge.

Dinner and snacks are either catered by an outside vendor or brought in by everyone attending the party. The social atmosphere is enhanced by outdoor activities such as volleyball games or even tournaments involving up to six teams of students and faculty, and by the pleasant environment around Putah Creek and the Rec Pool.

This year's Fall Gathering was held at the Rec Pool Lodge in the afternoon of October 25, 1995. Approximately 90 people joined the happy occasion. The Social Committee brought in fresh corn-on-the-cob, hamburgers, hotdogs, soft drinks, and chips, and set up one large hotbed of charcoals. Many people brought in salads, desserts, beers, and vintage wine. Before the dinner, Professor Richard Scalettar (a member of the Social Committee) organized six extremely competitive volleyball teams for an exciting tournament. The prize went to the "Flux-crepers", a team of graduate students from Professor Robert Shelton's group. The award for their victory was a great pizza dinner at Woodstock Pizza.

During the dinner, graduate students Bennett Corrado and Scott Tooker helped cook the corn, hamburgers, and hotdogs. As usual, everyone had a great time! ❖

Experimental Condensed Matter Physics

by Stephen Irons, graduate student

When Robert Shelton arrived at UC Davis from Iowa State University and the Ames Laboratory (USDOE) in 1987, he quickly established a strong program in experimental condensed matter physics. Specifically, our laboratory has concentrated on the discovery and properties of "novel materials." Originally, the focus was on the then-recently discovered high temperature superconducting oxides. In keeping with the emphasis on exploring physics through new materials, we have since expanded our research to encompass many types of superconducting and magnetic materials. Our lab includes facilities for synthesis of almost any compound accessible through standard techniques. Numerous furnaces, as well as two inert atmosphere dry boxes, allow us to make and handle a wide variety of materials. We can characterize our samples through thermogravimetric and differential thermal analysis as well as determine the structure with a computer controlled powder x-ray diffractometer. Two Quantum Design SQUID magnetometers (1 and 5.5 Tesla) allow us to further characterize samples, as well as perform experiments at temperatures from 1.7 to 800 Kelvin. External device control software also facilitates resistivity and Hall effect measurements. Two calorimeters (0.7 < T < 300 K) give us access to the vast amount of information available in the specific heat of materials.

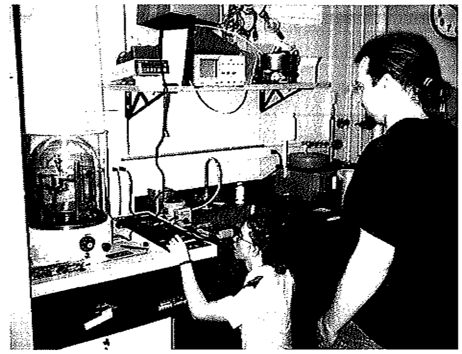
A recent graduate from our group, Tim Goodwin, investigated the role of praseodymium in the suppression of superconductivity and the onset of magnetism in the $(R_{1.5-x}Pr_xCe_{0.5})Sr_2Cu_2NbO_{10}$ system for R = Nd, Sm & Eu. This study was accomplished through an extensive series of magnetic, calorimetric, resistance, and X-ray diffraction measurements. The results of this work helped characterize and generalize the role of *f*-electron interactions in the suppression of superconductivity in high temperature superconducting cuprates by doping with praseodymium. In addition, it established criteria for modeling this suppression and refined our understanding of these phenomena. He has also, to the dismay of the rest of us, set the lab record for the longest dissertation. Because of the complexity of these compounds, work continues in this area.

Chance Hoellwarth is currently investigating the effect of doping cobalt onto the nickel site of the quaternary system YNi_2B_2C. He has investigated the relationship between the superconducting temperature (T_c), Fermi Energy (E_f) and lattice parameters and Co concentration by measuring the specific heat in the temperature range 0.5 - 60 K. The results imply that this new class of nickel-borides are conventional BCS superconductors with large E_f and moderately strong electron-phonon coupling. Due to these investigations, he has also learned more than he wanted to about thermometer calibration. With Paul Anderson, he is helping to develop a microcalorimeter that will allow measurement of samples with masses as small as a few milligrams.

The relatively recent discovery of superconductivity in the alkali doped fullerenes prompted us to develop a program to investigate them. Under the direction of J.Z. Liu and John Dykes, the synthesis and separation of buckminsterfullerene (C_{60}) was realized in 1992-93. Following this accomplishment was the growth of large single crystals of C_{60} that enabled us to dope them with the alkali metals potassium and rubidium to obtain superconductors (T_c = 19.6 & 30 K respectively). This work is being continued by Stephen Irons who has measured the effective critical current density $J_c(T)$ and the critical field $H_{c1}(T)$. He has found that differences exist between samples measured as polycrystalline powders and single crystals. Currently, Stephen is attempting to probe the defect structure of these materials by observing the relaxation of the vortex lattice under different temperatures and fields.

While not as fast moving as it once was, research into the high T_c oxides continues to provide challenging puzzles. In Chu Chang has been studying single crystals of $LuBa_2Cu_3O_7$. Measurements of the critical current density J_c through magnetic hysteresis and resistivity under different fields and temperatures have occupied much of his time. He has discovered that the experimental data that probed the two dimensional vortex structure are in good agreement with the vortex glass model. In addition, In Chu synthesized polycrystalline samples of $Tl_{1-x}Hg_xBa_2Ca_2Cu_3O_8$ which showed a superconducting transition of greater than 130 K with values of J_c that are comparable to the well-characterized $YBa_2Cu_3O_7$ system.

J.Z. Liu and Peter Klavins continue to be rich sources of information and expertise. J.Z. has been a pioneer in the growth of large, high quality single crystals of both the high T_c oxide and the now currently popular giant magnetoresistive materials, for example $La_x(PbCa)_{1-x}MnO_3$. Peter keeps all aspects of the lab running smoothly and continues to contribute immeasurably to all the research done in this group. He has recently begun performing calorimetry experiments on cement samples that are related to the controversial Yucca Mountain Nuclear Waste Repository.



Jodie Biggs and Leif Terry using an evaporator to make C60 thin film

An important part of the doctoral research program is finding a job once the degree is completed. While it is generally acknowledged that jobs have lately been more difficult to obtain, recent graduates from Dr. Shelton's lab have had a measure of success. Nancy Jia has secured a career position with the Xerox Corporation in Webster, New York after a two year post doc at Berkeley. Rose Zhang is an assistant professor at CSU Stanislaus. Dave Moseley and John Dykes both have positions with computer industry corporations. Tim Goodwin is currently working as a post doc with Dr. Subhash Risbud in the Chemical Engineering and Materials Science Department at UC Davis. David Barnes has recently been hired as the director of the UC Davis microfabrication facility within the UCD Department of Engineering.

The rest of us here are hoping to be so lucky! ❖

From left to right: Paul Anderson, Stephen Irons, Leif Terry, Jodie Biggs, Peter Klavins, Ji-zhe Liu, Chance Hoellwarth, Robert Shelton.

CMS Collaboration

by Winston Ko, professor

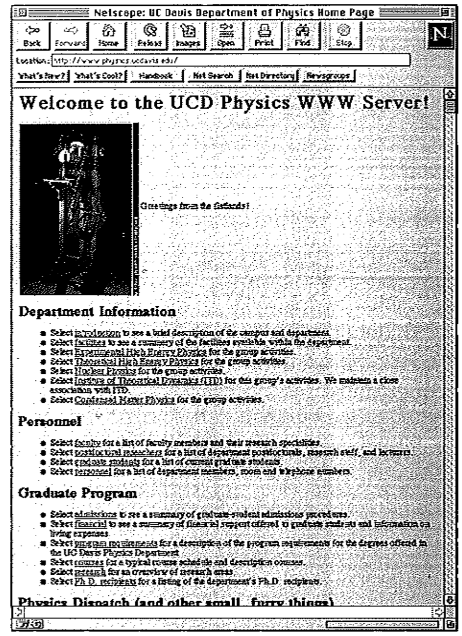
CMS Collaborators

The UCD experimental high energy group hosted an international meeting of the Compact Muon Solenoid (CMS) Collaboration October 25–29, at Granlibakken near Lake Tahoe. It was part of a series of week-long meetings of the future Large Hadron Collider (LHC) experiment held every three months. The CMS collaboration comprises around 1,300 physicists and engineers from 28 countries. The experiment is one of two large, general purpose detectors for the LHC that will be used to study proton-proton collisions at a center-of-mass energy of 18 TeV.

The LHC, to be built at the European Laboratory for Particle Physics (CERN) near Geneva, Switzerland, is generally considered to be the future of high energy physics following the termination of the Superconducting Super Collider. Reflecting the rapid increase in the number of U.S. participants since then, this was the first CMS week to be held in the U.S. Approximately 150 collaboration members attended, with two-thirds coming from outside the United States, including all of the CMS management based at CERN. There was in-depth discussion of the physics discovery potential of the experiment, to which members of the UC Davis theory group made significant contributions. Two representatives of the U.S. Department of Energy who attended made encouraging remarks concerning funding issues of concern to U.S. participation.

Members of the UC Davis high energy group were among the first from the United States to join CMS. The group's involvement has expanded to represent a major presence in many areas of CMS detector and software development. More details about the CMS Experiment and the participation of UC Davis will be presented in an article in a forthcoming issue of *Physics Newsletter*. ❖

Physics Home Page



For more information about the UC Davis Physics Department, browse through our World Wide Web home page at: http://www.physics.ucdavis.edu

Faculty News

Faculty Highlights

Professors **Ching-Yao Fong, Barry M. Klein, and Robert N. Shelton** of the UC Davis Department of Physics were elected to Fellowship in the American Physical Society this year.

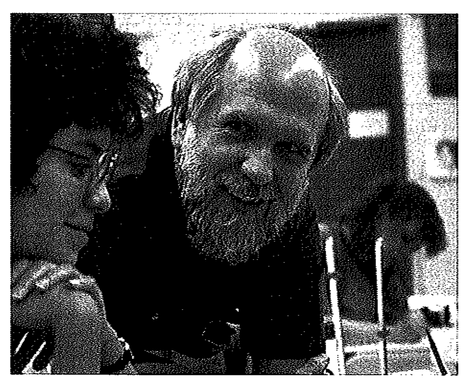
Robert Shelton

Professor Fong's citation reads: "For pioneering work in developing theoretical models and applying them to computational studies of the fundamental electronic and vibrational properties of semiconductor systems."

Professor Klein's citation reads: "For his contributions to the theory of electronic and vibrational properties of solids, and for building and leading dynamic research groups."

Professor Shelton's citation reads: "For his contributions to low temperature, high pressure studies of superconducting and magnetic materials."

Wendell Potter, vice chair and senior lecturer, has been chosen to receive a Distinguished Public Service Award for 1995-96. This award is presented by the Davis Division of the Academic Senate in recognition of significant contributions to the world, nation, state, and community through distinguished public service. Dr. Potter is being recognized for his involvement in formulating and implementing education theory into the pre-university educational infrastructure throughout the state of California. ❖



Wendell Potter

Physics 7—Looking For A Better Way

By Wendell Potter
Vice Chair and Senior Lecturer

Physics 7 students compare standing waves on a string and slinky with their representation as a superposition of the two traveling waves generated on the Mac.

Lower division physics has often been a painful experience for both the students and the instructor. Traditional approaches, consisting of large lecture classes and associated laboratories, have generated a "survival" mentality in many students, with the essence of physical reasoning and the scientific method often becoming casualties to "getting through it." The UC Davis physics department is taking a leadership role in developing alternative ways to provide lower-division instruction, initially focusing on the course taken by biological science majors.

In winter quarter 1995, just over 100 students enrolled in the first pilot section of Physics 7. In fall quarter 1995, another 150 students started a second pilot section. Beginning fall 1996, Physics 7 will entirely replace our current Physics 5, the large introductory course that is taken by more than 1200 bio-science students each year (previously numbered Phy 2 and Phy 6 for the old timers).

What's different about Physics 7? Almost everything. The course is redesigned to take into account what is known about how students learn physics and which teaching approaches are most helpful in encouraging students to learn how to "think physics" rather than just memorize algorithms for solving specific problems.

The emphasis in the new course is on encouraging students to become "active thinkers," rather than memorizors and regurgitators. For example, in traditional labs, the actual goal of both students and TAs is usually reduced to simply how to "get through" the lab with as little hassle as possible. The focus was on completing the list of things the lab write-up says you have to do. In Physics 7, the labs (which are now called discussion/labs and meet for five hours each week) are structured more as discussion sections along with activities that involve lab apparatus. Students typically work in groups of four or five and use the lab apparatus in response to a specific need: to become familiar with a particular phenomenon, to answer a particular question that has arisen in discussion, or to test out a model or a tentative explanation. In short, students are put in the position of being much more responsible for their own learning.

Another very different aspect of the new course is that it takes a spiral approach to the content. Rather than work linearly through a series of topics, the course organization is based on developing a functional understanding of basic principles and concepts. Many traditional topics are revisited several times throughout the course. For example, much of the first quarter deals with the broad concepts of interacting systems and the universal applicability of the energy concept; the rather artificial separation of topics into mechanical and thermal systems is not made.

Physics 7 is being developed by Professors Larry Coleman and Wendell Potter and Lecturer Charles De Leone. The effort is partially supported by a $310,000 NSF Undergraduate Curriculum and Course Development award. Teaching Assistants Mike Skolones and Lecturer Jesus DelCastillo contributed heavily during the first two quarters of the first pilot. Teaching assistants during the second pilot include Michael Anderson, Matthew Enjalran, Thomas Farris, Philip Rogers, and Raymond Verda. Some aspects of this new approach are an outgrowth of modifications of Physics 5A labs that were begun in 1991 by Professor Potter and Lecturer James Jadrich. Others who participated in a series of brainstorming sessions during the summer of 1991 included Robert Gallup, Tom Weideman, Phil Graves, Randy Sloper, and Randy Harris. ❖

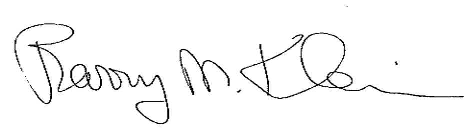
From The Chair *(continued from page 1)*

the growth of science "output" has pushed many physicists into becoming specialists in a sub-discipline with little hope for maintaining a generalist philosophy; and there is current growth in research that crosses department boundaries in the university system, with many targeted (funded) programs that put a premium on multidisciplinary, team research (say, physics, chemistry and engineering disciplines). These trends will influence how we implement our curriculum and, perhaps, how we grow as a department. Tough issues for us!

As I mentioned in the last newsletter, we feel that we need our alumni more than ever—their life experiences and associated wisdom—to help us in these changing times, as we wrestle with issues of curriculum (how much should it change?), recruitment of the best students (convincing them of the "Davis advantage"), job placement for our graduates, and further improving our faculty by recruiting some of the best new people to UC Davis.

You can help with some of the campaigns that we will get under way in the near future. We would like to begin to plan for, and get support for, an endowed chair in a branch of physics; we would like to be able to offer more financial support for our students from an alumni-generated scholarship fund; we would like our alumni to help us recruit the most talented undergraduate and graduate students for our physics program; and we would like to have our alumni help with the job-placement of our graduates. These issues will be discussed at our alumni day on April 13, 1996, which I hope you will attend. Your involvement will be most appreciated by us, and, we hope, rewarding for you.

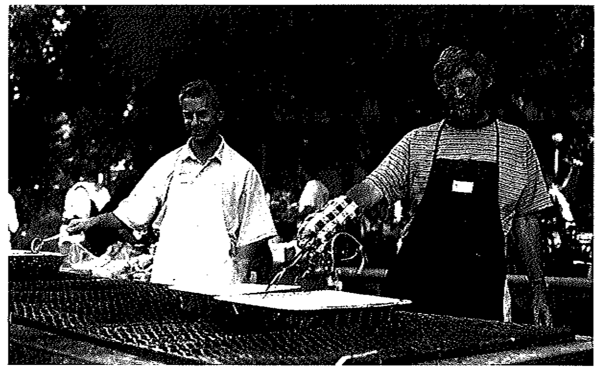
Sincerely,



Barry M. Klein

Fall Welcome '95

by Joseph Kiskis, professor

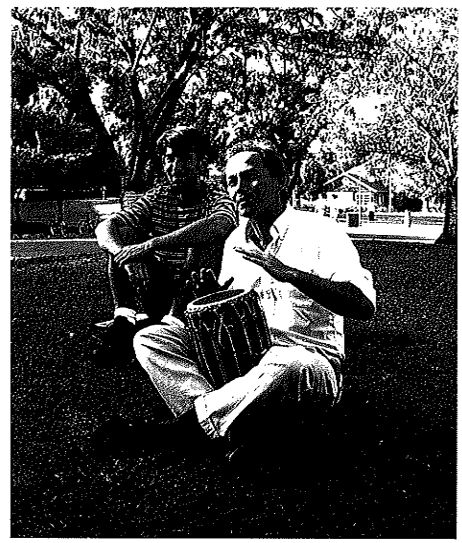


On the first day of class of the fall quarter, the Department of Physics, along with the departments of Chemistry and Geology, hosted the first annual "Fall Welcome" barbecue for the new undergraduate physical science majors of the Division of Mathematical and Physical Sciences. A picnic was held on the lawn to the north of the Physics/Geology building. This was no quiche and white wine affair; there were ample portions of hot dogs, hamburgers, potato salad, potato chips . . . you get the picture. It was an enjoyable event with many graduate students, faculty, and staff in addition to the new undergraduate students.

Faculty were employed in roles appropriate to their skills — meeting-and-greeting, cooking, and serving. There were statements of welcome from the department chairs and from the divisional dean, which, due to their grace and well-considered incisiveness, did not excessively distract the participants from the jolly pursuit of food and conversation. Post-event polling data determined that the event was a success. 100 percent of respondents agreed with the statement, "Hey, that was fun; let's do it again."*

Many thanks to all staff, students, and faculty who worked to make the event a success. Special thanks to Teresa Overstreet of the physics department and the managers of the other departments (Marilyn DeMoss, geology; Rebecca Robinson, chemistry) who put in many hours of planning, organization, and even quite a bit of real work. ❖

**Based on a survey of four adults conducted on the evening of 27 September 1995. The margin of error is +/- 50%.*



Astronomy Club

by Kyle Noderer, B.S. 1993

Pulsars, galaxies, planets, and comets! astronomy has interested me for nearly 15 years and was what led me to become a physics major when I came to UC Davis. The first quarter I was here, I took Dr. Robert Becker's astronomy class. Through this class I found out about, and became involved with, the Astronomy Club. I am still involved today—two years after graduation. The club provides an opportunity to explore the night sky either on your own or with others who are as interested as you.

The club has several telescopes that are used by its members. Our observatory on Hutchison Hall houses a 12.5-inch reflecting telescope that traditionally has been the main telescope used. On the roof of the Physics/Geology Building we also have an 8-inch Meade Schmidt-Cassegrain, an 8-inch reflector, and a 4-inch refractor built in the 1870s by Alvan Clarke and Sons. These are in addition to the eight 4.5-inch reflectors used for the astronomy class laboratory. All of these telescopes are available to be used by club members after a short introductory check-out session for each telescope.

In 1991, I was part of a small group that acquired a CCD camera for the club. It is mainly used for photometry, but has frequently been used for imaging. CCD projects have been done both for academic credit and simply for fun. Various projects have included calculation of extinction coefficients, tracking the life of a supernova, and determination of stellar luminosity vs. effective temperature.

In addition to using the CCD to capture images, there have been several of us who have experimented with astrophotography. Some of these pictures were developed in the astronomy darkroom. There have been several late nights and early mornings spent in search of the perfect picture!

Club members frequently show the night sky to the public through weekly public viewings, which are typically held on the roof of the Physics/Geology Building. Usually they are held on Friday nights, but recently they have been on Thursdays. Most quarters Hutchison Observatory is also open to the public, on Wednesday nights.

Members of the Astronomy Club are also very involved in the astronomy classes. The "roof helpers" who lead and teach the observational portion of the astronomy lab are all undergraduate students. Recently, even the TA for the classroom portion of the lab has been an undergraduate student—a practice that has been revived from many years ago.

We have also taken trips outside of Davis. Many of these have simply been to get away from city lights. Most fall and spring quarters, we take a tour of Lick Observatory, outside San Jose, and look at the sky through a 30-inch refracting telescope—much larger than any we have on campus. Other trips have taken us camping in Yosemite National Park or rafting down the American River.

The Astronomy Club is run by its members, almost all of whom are undergraduate students, under the general guidance of our advisor, Professor Emeritus Glen Erickson. Consequently, each year club activities are slightly different than those of the previous year. The opportunity to see what the night sky has to offer is still there, however, as is the desire to share our interest in astronomy. ❖

Ph.D. Degrees Awarded

September 1995

Gary Grim
"Doubly Cabibbo Suppressed D^+ Decays and Singly Cabibbo Suppressed D_s^+ Decays in 220 GeV g + p Interactions"
*Postdoc, Department of Physics, University of California, Davis

Jessica Kintner
"Squeeze-out and Flow of Pions from 1.15 GeV/nucleon Au + Au"
*Visiting Assistant Professor, Lawrence University, Appleton, WI

Jack Osborne
"Measurement of Neutron Elastic Scattering Cross Sections for 12C, 40Ca, and 208Pb at Energies from 52.5 MeV to 225 MeV with Angles from 7° to 23° "
*Lecturer, Department of Physics, University of California, Davis

Christopher Pike
"A New Preisach-Type Model of Hysteresis in Interacting Single Domain Particle Systems"
*Lecturer, Department of Physics, University of California, Davis

Bachelor's Degrees Awarded

Summer Quarters 1995

Quiroz, Claudio . . . . BS
(Degree in Applied Physics)

Zepeda, Salvador . . . . BS
(Degree in Applied Physics)

Correction: In Fall Quarter 1993 Kyle Noderer graduated with his BS in Physics, not AB as was stated in our last issue.

UC**DAVIS**
PhysicsNewsletter
is a publication of the UC Davis Department of Physics. It is published two times a year to provide information about the teaching, research, and service activities of the department. For subscription information contact: Joey Simoes, Physics Department, University of California, Davis, CA 95616; telephone: (916) 752-1500; fax: (916) 752-4717; email: simoes@physics.ucdavis.edu

Department Chair: **Barry M. Klein;** Department Vice Chair, Undergraduate Program and Administration: **Wendell H. Potter;** Department Vice Chair, Graduate Program: **Joseph Kiskis;** Design and Layout: **UC Davis Creative Communication Services**

Physics Department
University California, Davis
Davis, CA 95616

We'd Like To Hear About You!

Please return this form with news about yourself to be included in future newsletters. We are very interested in how you are doing and where your career has taken you. Please mail to: *University of California, Davis, Physics Department, Davis, CA 95616, Attention: Joey Simoes.*

Class of: ______________________________

Degree: ______________________________

Name: ______________________________

Current Employment

Title: ______________________________

Company/School: ______________________________

Address: ______________________________

Other News