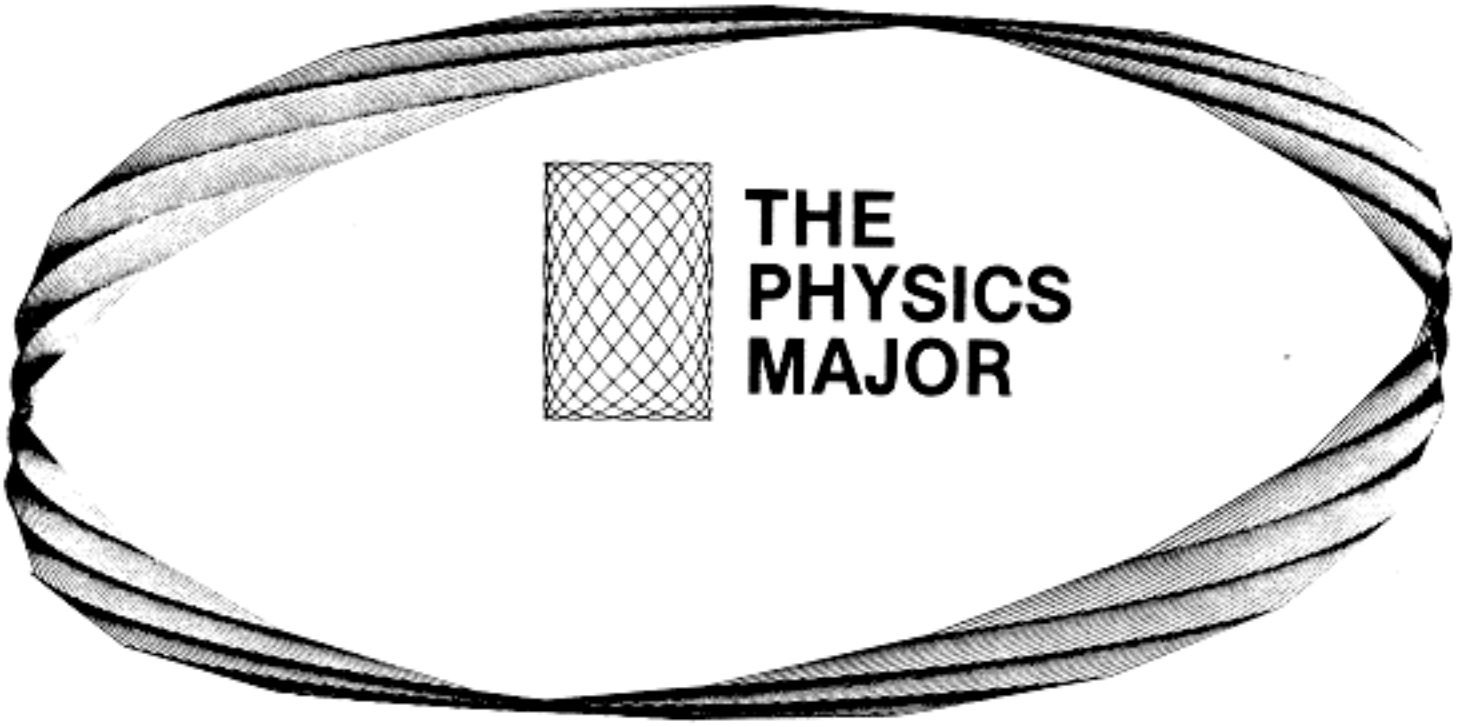

THE PHYSICS MAJOR

Radio Telescope On Its Way

by Kory White

Sonoma State University is one of only four universities out of 530 in the United States and Canada to receive a 1987 Society of Physics Students/Allied Corporation Foundation award.

The award, for $1600, means recognition for the radio telescope which is being built by the SSU Society of Physics Students chapter. And the cash will enable the students to buy some much-needed equipment.

The telescope is currently under construction on the roof of Darwin Hall. It will use electronics designed and built by engineers from Hewlett-Packard Company in Rohnert Park, among them SSU physics graduate Clyde Underwood.

Students Daniel Nottingham, René Woolcott, Jr., and M. Richard Mayer have been working on the astronomical, mechanical, and data acquisition and analysis aspects of the project. Their advisor is Dr. Lynn Cominsky.

"Radio waves are a longer wavelength version of visible light," explained Cominsky. "You cannot detect radio waves with your eyes. You need special equipment which sends data to a computer which then displays information on a screen."

The first stage of the SSU radio telescope uses four Quagi antennae mounted on long booms. This stage is now complete and has been used to detect radio emissions from the sun. The second stage, funded by the Allied award, will include a satellite dish which will increase the sensitivity of the telescope so that supernova remnants and radio galaxies can be observed as well. In the third stage, two satellite dishes will be used, one at each end of the roof of Darwin Hall. The result will be an interferometer, which will have much finer angular resolution than a single dish.

Dr. David Cudaback, a radio astronomer at UC Berkeley, is serving as a consultant on the project, which is expected to run for at least two more years.

Rahimi Research Wins Grant

A grant of $11,000 was awarded this spring by Pennsylvania State University to Dr. Saeid Rahimi to conduct research at Sonoma State University on space-charge controlled capacitance.

The measurements, which involve the mysterious concept of "negative capacitance," will be done by Dr. Rahimi with students René Woolcott, Jr. and Eric Anderson. Both students will be employed on the project over the summer.

Professor H. K. Henisch of Penn State secured the funding from the Batelle Memorial Institute with the proposal that all of the experiments be done at Sonoma State. Final approval came at a conference at the Institute for Amorphous Studies in Michigan where Dr. Rahimi discussed some preliminary results of the measurements he and the undergraduate students have been making.

Henisch, who was Rahimi's thesis advisor, recently transferred a considerable amount of equipment to the SSU Solid State Lab. The two are in daily contact via the computer network BITNET.

Rahimi has made considerable use of the Salazar Library's computer search techniques to keep up with the literature in the fast-moving field. "Without the help of librarians Haran Bronwyn and Tim Huston, I would not have been able to do anything," he says.

Faculty Win Awards

Three members of the SSU physics and astronomy faculty have been awarded $2500 prizes for Meritorious Performance and Professional Promise. Professors Lynn Cominsky, John Dunning, and Joseph Tenn were among the 36 (out of more than 300 faculty) winners in 1987. The three awards make a total of six awarded to the Department since the California State University system instituted the MPPP awards in 1985.

Students Speak At ANBS Meeting

Each spring since 1981, the Association of North Bay Scientists has brought together students and faculty from colleges and universities between the Golden Gate and the Oregon line for a day of invited lectures and research presentations.

After wandering from College of Marin to College of the Redwoods, the ANBS returned to its birthplace, Sonoma State University, for its 1987 meeting. A biologist presented the keynote address on evolution. He was followed by two topical symposia, one of which, *Visions of the Universe from Space: Satellite-Based Astronomy*, featured Dr. Thomas Chester of Caltech's Jet Propulsion Lab on the Infrared Astronomy Satellite and SSU's own Dr. Lynn Cominsky on X-Ray Astronomy with the Einstein Observatory.

The afternoon featured short papers presenting the results of research by students and faculty from half a dozen institutions. The five presentations on physics and astronomy were all by SSU students:

Daniel A. Nottingham: *The Evolution of Radio Astronomy at Sonoma State University*. (Independent Study with Dr. Lynn Cominsky).

M. Richard Mayer: *Data Acquisition and Analysis System for Sonoma State University's Radio Telescope*. (Independent study with Dr. Lynn Cominsky).

James L. Aroyan: *Theory and Design of Loudspeaker Cabinets*. (Senior design project with Dr. Tom Barnebey).

Bill Hinkle: *Designing Stage Monitor Speakers*. (Senior design project with Dr. Tom Barnebey).

Chris Ray: *Chaos In a Driven Diode Circuit*. (Independent study with Dr. Duncan Poland and Dr. Tom Barnebey).

New Laser Tube Means More Projects

Dr. Sam Greene, director of the SSU laser laboratory, reports that the new tube for the five-watt argon ion laser is now in place and operating. Student projects this semester, some of them under the supervision of chemistry professor Dr. Doug Martin, have included work on the laser fluorescence spectroscopy of iodine and related compounds. Next year it is anticipated that other compounds will be investigated.

"We have plans to use our solid state infrared laser in checking the properties of optical fibers and for demonstrating optical fiber communication," Dr. Greene reports.

"We also expect to begin a laser photoacoustic spectroscopy investigation of atmospheric pollutants and of other problems which involve trace concentrations of elements. We have most of the basic equipment needed for this and hope to have the system up and running some time next year."

The argon laser will continue to be used for large-scale holograms, some of them made with the assistance of Department technician and holography expert Steve Anderson.

Dr. Greene invites students to see him regarding independent study projects in the laser lab.

Reunion Brings Back Grads

Approximately 75 persons gathered by the lake on campus Sunday, May 17, for a combination physics graduate reunion and Society of Physics Students party. A catered barbecue was enjoyed by all. Graduates came back from as far away as Salt Lake City (David Shoaf, '75) and Los Angeles (Allyson Bishop, '86) and from as far back in time as the class of '69 (Bill Parr). They shared their experiences in industry and graduate school with current physics majors, and all enjoyed reminiscing with the faculty. Dr. Isaac Bass, now a researcher at the Lawrence Livermore National Laboratory, came back to visit with some of his former students and colleagues. It seemed hard to believe he has been gone eight years.

A highlight was the reading of a history of the SSU Department of Physics and Astronomy by long-time Observatory stalwart Miriam Carolin ('82). She had prepared it jointly with Joanne del Corral ('83).

This was the Department's second reunion. When will the third occur?

Scholarships Available

Each year Sonoma State University awards a number of scholarships based on academic merit without regard to need. The awards, contributed by local companies and individuals, are mostly in amounts of $500 or $1000. One scholarship, the *Joe S. Tenn Scholarship*, is always awarded to a physics major. It is donated by Tenn's brother and sister-in-law each year as a birthday present to him.

In 1986-87 three physics majors won scholarships. Ken Ritley and Chris Ray, both double majors in physics and mathematics, were awarded *Dryden Scholarships*, and Alan Gering, a double major in physics and English, won a *Sally L. Ewen Memorial Scholarship*. The *Tenn Scholarship* winner was unable to accept it, so there will be more money available next year.

There is no reason why physics majors shouldn't win more scholarships. Those with excellent academic records should apply. Applications for each academic year are due in mid-March. Students who will be entering the University in the Fall are particularly encouraged to apply, as some scholarships are reserved for entering students.

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Physics Majors Do Well In Math Contest

Physics and math major Brian Nottingham was the highest scorer at SSU on the William Lowell Putnam exam in 1986.

Regarded as a major international competition, the Putnam Exam began in 1939 and is run by the Mathematic Association of America.

"The Putnam exam consists of highly challenging problems," according to Dr. Rick Luttman, SSU mathematics professor and coach of the Putnam team. "Solutions to these problems require creativity, agility of mind, brilliant mathematical insight, and excellent problem-solving ability."

This year's competition drew 2094 contestants from more than 300 institutions from throughout the United States and Canada. Nottingham placed in the top 15% and received a local prize of $1000. Physics and math major Ken Ritley, among the top 22% of the contestants nationally, was second locally and received $150. Local prizes come from a fund established by SSU math faculty and the estate of Sonoma County Supervisor Helen Putnam (no relation).

This was the seventh time in the last eight years that physics majors won the top local award. Previous high scorers at Sonoma State were Chris Ray (physics and mathematics), 1985 and 1984, Geoff Wilson (physics), 1983 and 1982, Doug Brown (mathematics), 1981, and Richard Montgomery (physics and mathematics), 1980 and 1979. Wilson recently transferred from Stanford to the Oregon Graduate Center, where he is working with SSU graduate Dr. Rick DeFreez. Montgomery completed his Ph.D. in mathematics at UC Berkeley (with a physics-related dissertation) in 1986 and is now a Miller instructor at M.I.T.

DeFreez Research Lauded

Research by SSU physics grad Rick DeFreez was cited by *Optics News* as among the twelve most important advances in optics in 1986.

DeFreez, now an assistant professor at both the Oregon Graduate Center (OGC) and Portland State University, reported a significant advance in the art of forming optical quality microsurfaces. He and his coworkers have found a way to machine surfaces on a scale of micrometers. They have used the technique to make semiconductor diode lasers that promise to have important uses in communications between satellites.

A graduate of Santa Rosa High School, DeFreez earned his B.S. in physics at SSU in 1980. While an undergraduate student he twice won American Physical Society internships which enabled him to conduct research on remote detection of molecules using lasers at the Bethlehem Steel Corporation's research labs in Pennsylvania.

He earned his Ph.D. in applied physics at OGC in 1985, five years after entering with his own research contract from Bethlehem. Together with coworkers he has patented two inventions and published fourteen scientific research papers. He described this work in SSU's "What Physicists Do" series in April.

SSU Active In Astronomical Meetings

Sonoma State University was well-represented at the 169th meeting of the American Astronomical Society, held in January 1987 in Pasadena. Dr. Lynn Cominsky and a colleague from the Naval Research Laboratory presented "Further X-ray Observations of MXB 1659-29." Dr. Gordon Spear and coworkers at the University of Nebraska presented "Light Curves for Cepheids in NGC 6822." And Dr. Joseph Tenn chaired a session on the modern history of astronomy. Dr. Tenn also enjoyed the auxiliary tours of the Palomar Mountain Observatory and archaeoastronomy sites in southern California.

Last July Dr. Tenn spoke on "The Bruce Medalists" at the 98th annual meeting of the Astronomical Society of the Pacific in Boulder, Colorado. He was recently elected to the A.S.P. history committee, in time to help prepare for the Society's centennial.

History Course Stimulating

by Kenneth Ritley

Physics students have been studying alchemy, astrology, phlogiston, and the electric fluid this semester at SSU. Have the professors gone nuts? No! These are all subjects covered in Physics 400 History of Physical Science, a course offered every other spring.

Physics 400 is a survey course that deals with the history and development of modern physics. It traces the origin of physical theories from the ancient Greek and medieval Arab beliefs through the modern quantum theory of the twentieth century.

The instructor this year is Dr. Pat Rife, a visitor to the Department who also teaches at National University. She obtained her doctorate in the social history of twentieth century science at the Union for Experimenting Colleges and Universities in Cincinnati in 1983. Her dissertation was on Lise Meitner, an Austrian-born physicist who worked with Max Planck and Otto Hahn in Berlin and who played an important role in the discovery of nuclear fission.

Dr. Rife has conducted historical research at Harvard, M.I.T., and the Nobel Institute in Sweden, as she has traveled to interview scientists associated with Meitner and the beginnings of nuclear physics. She is currently producing a film, *Chain Reaction: Dawn of the Nuclear Age*.

Although the course covers a large portion of history, its main emphasis this semester has been on the twentieth century, especially the development of the quantum theory. Students are given a rather hefty amount of required reading, and they are asked to write three short research papers, prepare and present to the class a fourth paper, and submit a carefully prepared and documented final paper.

"It's not an easy course, but it's the best physics course I've ever taken," remarked a current student.

Pat Rife believes, "All science students should take a history course to broaden their perspectives in their own discipline and trace the underlying themes which have emerged." Thanks to her and to Physics 400, physics majors this semester are doing just that.

Cominsky Enjoys First Year At SSU

by Miriam Tobin

When the Space Shuttle Challenger exploded in the bright blue morning sky over Cape Canaveral, the havoc that ensued changed countless lives, put the shuttle program on hold, and became the major impetus for Dr. Lynn Cominsky's return to Sonoma State University. On the day of the tragedy, January 29, 1986, Dr. Cominsky was working in the Space Sciences Lab at UC Berkeley. She was manager of a satellite project, the Extreme Ultraviolet Explorer, that was scheduled for launch from a shuttle sometime in 1988. After the Challenger disaster, however, the launch date was put off until 1994 at the earliest. This meant a possibility of managing for another ten years, a prospect she did not savor. She didn't like managing--"It was not very much like being a real scientist," she says.

So when Sonoma State advertised a permanent teaching position that spring, she applied, and when, after a nationwide search, the Department made her its first choice, she unhesitatingly accepted.

Dr. Cominsky had taught one course here in Spring 1982, so she was not a complete stranger to Darwin Hall. She says she missed Sonoma State in the five years since then, and she was very happy to be back among the students and faculty of the Department of Physics and Astronomy.

She missed teaching also, but, because her first full-time semester involved tackling four unfamiliar physics classes, she rates the fall of 1986 a close second to her first semester of grad school at M.I.T. in difficulty. The Spring '87 semester was a little easier and freer for her. The University awarded her an Affirmative Action Professional Development grant, which allowed her to teach only three courses instead of four. She has spent the extra time revamping her classes, selecting a new text for the modern physics course, and, along with Dr. John Dunning, rewriting some of the Physics 116 experiments. The feedback from her students in this traditionally rigorous first laboratory course has been very positive.

Positive also is the feedback from Lynn to her students. She is very impressed by the dedicated, hard-working physics students at Sonoma State. She finds that, perhaps because many are older, they are serious about their studies, they are very motivated, and they do their homework.

She gives a special rating to the students in her Physics 412 Microprocessor Applications course. She has them designing projects according to their interests, and some have actually spent their own money to buy parts and construct the devices they have designed.

Lynn is also the advisor for the student group responsible for the radio telescope atop Darwin Hall, and she had a hand in getting funding for the project. She and Dan Nottingham, president of the Society of Physics Students chapter, wrote the proposal for the award that brought them $1600 for the project. The money will go toward the construction of an interferometer this summer. With the interferometer in place, higher spatial resolution will be possible, and the group can graduate from daytime viewing of the sun to nighttime viewing of Casseopia A, the strongest supernova remnant, and Cygnus A, the strongest radio galaxy.

Lynn Cominsky does not shy away from anything that interests her. Her third semester at SSU will find her taking on even more responsibilities. She has agreed to take over direction of the "What Physicists Do" public lecture series, and, in her spare time (what spare time?), she will begin work on a research project in x-ray astronomy, her research field. NASA has just awarded Lynn a $53,000 grant, which will take her to the Netherlands this summer to collect data from recent x-ray satellite telescopes and will enable her to hire a dedicated and committed student to help analyze this data over the next two years.

She will still do what she likes to do best--teach. When asked if she plans a future here at Sonoma State, she replied enthusiastically, "Sure do. I love this place! As long as they want me, I'm going to stay."

You know, Lynn, something tells me that they want you.

Ritley Selected For Summer Program

This summer SSU physics major Kenneth Ritley will be conducting research at the Oak Ridge National Laboratory. He will be working on the analysis of thermodynamic properties of metals and superconductors, using pair potentials and Monte Carlo methods.
There will be a lot of supercomputing on a Cray after developing programs on a VAX.

Ritley came to SSU from Irvington High School in Fremont in 1984. He had taught himself calculus while in high school and came in with college credits for advanced placement English as well. At Sonoma State he has successfully challenged several of his general education courses.

This has left time for a double major. Ken expects to graduate next year, completing a B.S. in both physics and mathematics in just four years. After that it will be graduate school in elementary particle theory, probably in the Northeast. Ken and his father spent the January break visiting a number of universities in New York and New England in preparation for the big decision. Ken moved to California from his native Cleveland at age 13, so he remembers ice and snow. In fact, he is anxious to return to them.

Currently vice president of the SSU chapter of SPS, Ken is also the senior tutor for the natural sciences at the campus Learning Center. He is responsible for organizing tutorial services for physics, chemistry, and biology. His tutoring should be good preparation for being a teaching assistant in grad school.

Ritley has really enjoyed Dr. Sam Greene's electricity and magnetism course this year. He has even delved into the history of the subject, writing papers for Dr. Pat Rife's History of Science class on Maxwell and Poynting.

Gordon Spear's Active Sabbatical

Students accustomed to working with Dr. Gordon Spear at the SSU Observatory or to accompanying him on observational trips to larger observatories will not be surprised to learn that the popular professor is busy working on variable stars while on sabbatical leave this year.

Students who have taken Dr. Spear's scientific programming class will not find it surprising that he is spending a lot of time developing software.

At the University of Nebraska, where the SSU Observatory Director is spending the year, he is developing software to analyze stellar photometry in crowded fields.

How crowded? He and his colleagues are examining individual stars in other galaxies in the Local Group. They are finding variable stars, mostly the pulsating kind known as Cepheid variables, and determining their light curves.

At a recent regional meeting in Kansas City, Dr. Spear reported the discovery of 82 new variables in the galaxy known as NGC 6822. It was in this same galaxy that Edwin Hubble, in the 1920s, found the first evidence that the "nebula" NGC 6822 was actually another galaxy, well outside the Milky Way.

The work that Hubble and his successors did with the 100-inch telescope on Mt. Wilson and even with the 200-inch instrument at Palomar Mountain is now being extended with a 30-inch telescope at McDonald Observatory in Texas, according to Spear. The difference is the detector. Where Hubble used photographic plates, which record only 2 or 3% of the light which falls on them, Spear is now using Charge Coupled Device (CCD) detectors. These solid state electronic devices record as much as 70 - 80% of the light which they receive. What is more, the data are stored digitally. Where Hubble stared at photographs taken at different times, blinking back and forth in a search for variability, Spear does it all in the computer.

Gordon intends to continue the research at SSU next year. He already has a CCD system on order for the campus observatory. "All I need now," he says, "is a MicroVAX computer." And, of course, some students to work with him.

Foreign Students Enliven Department

The SSU department of physics and astronomy is enriched by students from Europe, Asia, and Central America.

Taha Ali is from the Middle East. He studied in Scotland before coming to SSU in 1986. Interested in mechanical engineering, he expects to transfer to an engineering school after completing his introductory physics, chemistry, and mathematics.

Imme Conley is from Germany. Since completing high school there in 1982 she has attended Methodist College in North Carolina and Monterey Peninsula College. "The climate at Sonoma State is really nice. It is not student against student here," she says. "Students help each other."

This is the first semester of college for Walterio Lopez, a refugee from Nicaragua. He spent last year studying English at San Rafael High School.

A native of Lebanon, Iad Mirshad is in the U.S. to stay. "High school in Lebanon is much, much harder and more serious than here," he reports. "There are no electives. Everyone takes math and physics throughout high school, sometimes two physics courses and two math courses at the same time. Iad came to SSU in 1983, starting out in the Sonoma State American Language Institute. Now a junior, he is one of the department's top students, and he is planning for graduate school in particle physics in 1988.

New to SSU--and to the United States--this semester is Jing-ru Wang. Jing-ru earned her bachelor's degree in aeroengine designing at the Northwestern Polytechnical University in China. She is here to improve her English, then transfer for advanced work in aeronautical engineering.

Mieko Yoshida earned her bachelor's degree in western philosophy at Otani University in Kyoto, Japan. Now her interest is physics and astronomy, as described in another article.

There are several other students in the department who, although now American citizens, received much of their early education abroad. Among them are Art Onwan from Thailand, Lou Sanchez-Chopitea from Argentina, and Philippe Argouarch from France. All enrich the department with their experiences and knowledge of other cultures.

Alumnotes

KEVIN ABLETT (BS, 6/83, physics) has accepted a position as a software engineer with Island Graphics in Santa Rosa.

PAULA BENNETT (BS, 6/86, physics) is a student in the master's program in biomedical engineering at California State University, Sacramento.

L. RUS BEST (BA, 6/86, physics) is a graduate student in civil engineering at California Polytechnic State University, San Luis Obispo.

ROBERT M. BILODEAU (BA, 6/83, physics) is a senior claims representative with State Farm Insurance Companies in San Jose.

KEITH BRISTER (BS, 6/82, physics) is a graduate student in applied physics at Cornell, studying oxygen and germanium under one million atmospheres of pressure. He received his M.S. in 1985.

RICHARD BROMAGEM (BA, 5/75, physics) is a field engineer with Mountain Computer Company, Scotts Valley.

EARL BOYSEN (BS, 5/75, physics and chemistry) earned a master's degree in engineering physics at the University of Virginia in 1981. He is now a device engineer at INMOS in Colorado Springs, Colorado.

BENJAMIN BURRESS (BA, 6/85, physics) is a Peace Corps Volunteer in Cameroon, West Africa, teaching high school mathematics and physics.

Student Profile: René Woolcott

Go down to the basement of Darwin Hall and enter Dr. Rahimi's solid state lab. Chances are you will find René Woolcott conducting research on gallium arsenide. Some other time try the roof of Darwin. You may find René adjusting the radio telescope.

Yes, he takes classes, but René spends a great deal of his time on individual projects.

Woolcott has long been an individualist. Born in Switzerland and raised in the eastern United States, he entered Whittier College as a freshman physics major after high school in Connecticut. After one year he ran out of money and transferred several times--to Santa Monica City College, Diablo Valley College, and UC Berkeley. Dropping out, he developed many skills, working as a locksmith, mason, carpenter, and jack-of-all-trades. Soon he was developing property in southern California, then heading up the maintenance division of a manufacturer of clay sewer pipes.

It was a period as an independent real estate investor that brought him the financial security and leisure time to think of going back to his first love:

"I always wanted to develop an expertise in physics. I am a curious person at heart. Physics is the study of the nature of things."

As an investor, he had already chosen Sonoma County as the place to live. By the time he entered Sonoma State at age 30 in 1984, he had accumulated enough units to be a senior in college, but only a freshman in terms of physics.

This doesn't bother Woolcott. "I am not in a hurry. I am going to school to learn," he says with a smile. He has planned a lengthy program that will see him graduate in 1990 with a B.S. in both physics and applied mathematics plus a minor in computer & information science.

While he fully expects to go to graduate school, he is not waiting to get started on the research and scientific apprenticeship which usually begin in the second or third year of graduate study. For the past year he has worked with Dr. Rahimi in setting up the solid state lab. Last summer he built equipment, helped outfit the five stations for students and the one for research, and began what he is doing now: looking into the bulk properties of materials such as gallium arsenide and the semiconductor devices that can be made of them. He has been exploring the Hall effect and the Van der Pauw technique to determine the conductivity of samples as a function of temperature. While he is one of the five students in the semiconductor physics class, he also works on his own. This summer he will continue the research with Dr. Rahimi.

He also works with the team from the Society of Physics Students and cooperating Hewlett-Packard engineers on the radio telescope project. It was René who built the four Quagi antennae with which the team first detected the sun in March. He is also working on obtaining satellite dishes for the second generation collector.

Not surprisingly, he is enjoying the theoretical course in electricity and magnetism he is taking from Dr. Sam Greene. It is relevant to both of his projects, he reports.

According to René, "One of the most intriguing things about Sonoma State is its relatively small size. The reason I like it is the personal rapport you can enjoy with professors and other students."

Nuclear Lab Leads To Careers

by Debra Grace Khattab

How often have you come out of a course knowing that you have learned something useful? Students who have taken Dr. John Dunning's Applied Nuclear Chemistry and Physics course testify that the course was more than useful: it introduced them to a whole new field.

Allyson Bishop and Keyvan Farahani, SSU physics graduates in 1986 and 1985 respectively, were both awarded fellowships in the Ph.D. program in medical biophysics at UCLA. This highly competitive program admits only six students each year.

At the May 17 graduate reunion, Allyson talked about the SSU nuclear lab. She said that the class was a good introduction to the equipment and application of nuclear physics, and that it was where she first learned of the medical applications of nuclear technology. The graduate courses she is taking now are a direct continuation of what she started in the basement of Darwin Hall.

Many others have gotten their start in the course. Kitty Chelton, a 1981 graduate in physics and biology, earned a master's degree in biophysics at UC Davis and has also been working in the biomedical field.

Bruce Clark, '86, and Tim Finnegan, '84, work for Diasonics, MRI in South San Francisco. Tim earned a master's degree in nuclear engineering at the University of Wisconsin first.

MRI is Magnetic Resonance Imaging, the application of nuclear magnetic resonance to imaging the human body. It is rapidly replacing CT scanning for some medical applications. Tim is now designing a new, smaller version of the ten million dollar system he has been installing in hospitals around the country. Recalling the SSU nuclear course, Tim says, "It was a good introduction to what engineers do out there in the real world. The course and Dr. Dunning got me interested in the nuclear field. He is a great man and a great teacher. He has a world of knowledge, and students should take advantage of it."

Dr. Dunning recalls that he got the idea for the course from a summer he spent at Los Alamos. He studied neutron activation analysis (it can detect a trace amount of mercury in a can of tuna) and taught himself liquid scintillation techniques for detecting beta decay. He later studied alpha particle techniques in another summer program at Oak Ridge National Laboratory.

All three of these methods, and more, are taught in the applied nuclear chemistry and physics courses at Sonoma State. Students learn to use the equipment, to measure concentrations of heavy metals in their own hair, and to detect carbon-14 tracers in biological systems.

A new x-ray detector is the latest addition to the lab. Students can now use x-ray fluorescence as an additional method to detect heavy elements. Both lecture and lab courses are offered each fall. They can open a whole new field.

Student Profile: Valerie Leppert

Valerie Leppert has found that she is in demand. Seven graduate schools--UC Berkeley, UCLA, Northwestern, Penn State, USC, Virginia, and Vermont--have offered her assistantships. Each school wants the SSU senior to pursue a Ph.D. in materials science in its department.

Leppert will receive a B.A. in June with a double major in physics and chemistry, either of which would be a solid background for entering materials science. She is already an SSU grad, having received a B.A. in biology a year and a half ago.

Leppert's present home in Sebastopol is not far from where she grew up. After graduation from El Molino High School in Forestville, she attended Santa Rosa Junior College and then joined the Army Reserves. Training at Fort Dix, New Jersey, and Fort Sam Houston, Texas, made her a medic with a six year obligation that will soon end. Her annual service, monthly training, and availability to serve in case of emergency have been rewarded with financial support that has allowed her to pursue her varied scientific interests.

After visiting several of the graduate schools, Leppert has decided to get her doctorate at Northwestern University.

"It's a well-established department," she notes, "one of the oldest in the country." They offer most of the major areas in materials science. I am interested in thin films, particularly with applications to semiconductors."

"There are a number of people working in the field there, and the equipment is excellent."

Leppert is no stranger to equipment. At SSU she has become adept with nuclear magnetic resonance, high vacuum techniques, transmission electron microscopy, x-ray fluorescence, and Fourier transform infrared spectroscopy. She has also used a five-watt laser and is currently taking courses in electronics and precision machining.

After graduating the first time, she worked for Anatec in Santa Rosa on a project monitoring fish and water fleas with a video-computer system to develop an early warning system for water pollution.

To what does she attribute her success?

"I think Sonoma State provides a good education for people who are going on in physics and chemistry. I put a lot of work into my statement of purpose and focused on my laboratory experience and experimental skills. I believe this experience was more important than my grades."

Tenn Scores Again In Essay Contest

Dr. Joseph Tenn has been awarded honorable mention in the 1987 *Griffith Observer* essay contest. He will receive a cash prize, and his article, "The Rise and Fall of Astrophotography," will appear in the magazine. It was the sixth time an article written in the SSU Department of Physics and Astronomy has won a prize in the annual contest. Dr. Tenn has now won four, and students Reiko Hibbett Crane and Donald Martin have each won one.

Alumnotes

WILLIAM P. CABRALL (BA, 6/76, physics) is Titan IV Mission Manager at Martin Marietta in Denver, Colorado. He received an M.B.A. in finance at the University of Denver in 1986.

BRUCE CLARK (BA, 1/86, physics) is an installation engineer with Diasonics MRI Division in South San Francisco.

PETER CONWELL (BS, 1/76, physics) is a computational physicist working on neural networks for Unisys in Salt Lake City. He earned his Ph.D. in physics at the University of Utah in 1986.

KEYVAN FARAHANI (BS, 6/85, physics) is a graduate student in biomedical physics and research assistant in the nuclear medicine and biophysics laboratory at UCLA.

TIMOTHY FINNEGAN (BS, 6/84, physics) installs magnetic resonance imaging systems for Diasonics, MRI of South San Francisco. He earned an M.S. in nuclear engineering at the University of Wisconsin, Madison in 1986.

ROY W. HARTHORN (BA, 1/78, physics) is an assistant building official for the City of Santa Barbara and working on a master's degree in public administration at California State University, Northridge.

DAVID K. HAWK (BA, 6/77, physics) is a scientific programmer at Lockheed Missiles and Space Company, Sunnyvale.

MARY HOWLAND (BA, 6/86, physics) is a physicist at Sola Optical U.S.A. in Petaluma. She was formerly an engineer at Parker Compumotor.

MICHAEL INGERTSON (BA, 6/77, physics and special major: history and philosophy of science) earned an M.A. in theology from the Fuller Theological Seminary and another M.A. in the history and philosophy of science at the University of Pittsburgh. He has been a manager of several companies in the health care and computer software industries and is now president of WORLDVIEWS Marketing, Inc.

GARY JOHNSON (BA, 6/84, physics) is a pilot in the U.S. Air Force working on rendezvous flight design with the space shuttle team at the NASA Johnson Space Flight Center.

JON JURGOVAN (BS, 6/85, physics) is a graduate student in electronic engineering at California State University, Fullerton. After getting a master's degree he plans to study law.

WILLIAM L. KRAMER (BA, 6/77, physics and English) is manager of postal products engineering at National Controls, Inc., Santa Rosa. He also teaches electronics in the evening at Santa Rosa Junior College.

DAVID LAPP (BA, 6/84, physics) is teaching physics at James B. Conant High School in Hoffman Estates, Ill. He earned his teaching credential at SSU in 1986, while teaching part-time in the SSU Department of Physics & Astronomy.

Department Evaluated

During the past year the Department, under the leadership of its chairman, Dr. Duncan Poland, has been engaged in a lengthy self-study of its academic programs. By California State University policy, each academic program is reviewed every five years and a report on the findings is submitted to the faculty Educational Policies Committee and to the campus Administration. The faculty has spent many hours, including one full day at the Dunning residence, discussing aspects of its curricula and its support facilities. The comments of past graduates in response to our inquiries were very helpful.

Dr. Sumner Davis, Professor of Physics at the University of California, Berkeley, served as the off-campus evaluator. He met with the faculty on several occasions, talked to students, and interviewed several deans. Professor Davis' own report, which will be forwarded with the departmental report, is complimentary toward the department's efforts: "As judged by the results of individual interviews, reviews of selected course outlines, visits to the laboratories, and comments from students, the teaching is unusually good."

As a result of this review the department has made a commitment to improve the equipment for the lower division laboratories and to better coordinate the lectures and laboratories for these courses.

Student Profile: Mieko Yoshida

When East meets West, things happen. One of these is first year physics student Mieko Yoshida, newly arrived from Japan. Enthralled by the mystery of the physical universe, she is at last fulfilling her dream of studying physics.

Mieko earned a B.A. in western philosophy at Otani University because her high school provided insufficient background for her to be admitted to the physics program. She wrote her undergraduate thesis on German existential philosopher Karl Jaspers after reading his works in the original German.

The transition from living at home in the suburbs of Kyoto to dorm life in the United States was a revelation to Yoshida. "The lifestyle here is very different," she noted. She found the students here noisier and messier than those in Japan. American students study less and party more.

Mieko enjoys the hands-on experience of the introductory physics laboratory. Particularly fascinated by astronomy, she has long been an amateur astronomer. She left her telescope home in Japan, but this fall she will take the first course in astronomy for scientists.

So far Mieko has been successful in her pursuit of physics here at SSU, and she has helped to internationalize the Department.

Alumnotes

ANTOINETTE MATTHIES (BA, 6/84, physics) recently resigned as technical coordinator at TEGAL Corporation, Petaluma and is now vacationing on Maui.

Alumnotes

JAMES A. McBRIDE (BA, 5/75, physics) is vice president and national accounts manager for the payment products division of Citicorp. Jim earned a B.A. in mathematics at SSU in 1976 and an M.B.A. at Pepperdine University in 1983

STEPHEN MESSINGER (BA, 6/86, physics) is in the secondary teaching credential program at SSU. He is currently student-teaching at Kelseyville High School and will teach in the EXCEL program for gifted junior high school students at SSU this summer.

RICHARD MONTGOMERY (BA, 1/81, physics and mathematics) is a Moore instructor teaching and doing research in mathematics at the Massachusetts Institute of Technology. He earned his Ph.D. in mathematics at the University of California, Berkeley in 1986 with a dissertation applying modern mathematics to classical physics problems.

JOHN C. NELSON (BS, 6/76) is a senior optical engineer at the 3M Optics Technology Center in Petaluma.

JOHANNES RAAB (BS, 6/79, physics) received his Ph.D. in experimental particle physics at the University of California, Santa Barbara in 1987 and accepted a post-doctoral research postion at CERN, Geneva.

MANUEL A. "TONY" SALAZAR (BA, 6/86) is a sales engineer with Hoya Optics in Fremont and working on an M.B.A. degree at San Francisco State University.

DAVID W. SHOAF (BA, 5/75, physics and psychology) is a software designer for J & K Computer System, Inc., Salt Lake City, Utah.

LEE STEELE (BA, 6/85, physics) is a senior technical writer working for a computer-aided engineering/design software company in Menlo Park.

FRANK VAN GIESON (BS, physics and applied mathematics) is now a senior engineer with Western Digital Company in Orange County. He earned an M.S. in materials science at M.I.T. and worked at National Semiconductor Co. in Santa Clara for several years.

A Pedestrian's Guide To Fermilab

by Juan Reyna (B.S., 1/87)

Working as an accelerator operator at Fermi National Accelerator Laboratory is the most exciting thing I have ever experienced. Fermilab, as the laboratory is popularly known, is the world's largest particle accelerator currently in operation. It is a scientific wonderland. Consider the following: On a daily basis, antiprotons (called "p-bars") are created, accumulated, and stored. After enough of them are "stacked", they are accelerated up to energies of one trillion electron volts. The result is a hint at the nature of the universe. The Tevatron (so called because it accelerates particles up to one trillion electron volts) works through the use of superconductivity and is the very first large-scale use of that phenomenon. It is the first superconducting particle accelerator.

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A Pedestrian's Guide To Fermilab

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These things, and many more, make Fermilab such an exciting place to be.

Upon entering Fermilab for the first time, one is met by a sixteen story building known as the "high-rise." It is so called because it is the tallest feature in the prairie atmosphere of Batavia, Illinois. The high-rise itself is an interesting building. The north and south walls are parallel to each other and go up vertically in the normal fashion. The east and west sides, however, curve inwards in a hyperbolic curve. I was informed that such a structure causes wind currents to circulate around the building. While this is odd, I can testify to the truth of the matter. One particularly windy day, I threw up a few paper napkins. A gust of wind caught the paper and, at approximately fifty feet per minute, carried it around the building!

There are many buildings here. Some are large and oddly-shaped, while others are small and cubical. Each has its reason for being here, and all are most tastefully painted in solid blues, reds, and other colors. There is also a grand collection of ducks and Canadian geese that decorate the ponds and lakes.

Most suspicious of all are the large bumps of earth stretching from one place to another throughout the grounds. These are called berms, and twenty feet below them are the few thousand magnets that focus the proton beam to its various targets. It is the job of the accelerator operator to steer the beams, which move at nearly the speed of light, by manipulating the fields in these magnets. Also, the operator must perform general maintenance on any malfunctioning parts. For this reason, he must learn the entire accelerator. Even though specialists correct technical faults, the operator must be able to trace any malfunction down to the PC-board level. It is no wonder that the job requires two years to learn.

There are twenty operators in all, working on a rotating shift that occasionally leaves one with a four-day weekend (a fringe benefit). I have been very much impressed with this group. They are all hard-working people who care very much about quality. It is quite an honor to be one of them. They are from all over the United States, with backgrounds in various fields, including meteorology and biology!

Fermilab has many guest lecturers. Unfortunately, I missed a lecture by Stephen Hawking (he spoke with the use of a tiny amplifier on his throat). I did, however, have the privilege of speaking with T. D. Lee, who shared the 1957 Nobel Prize with C. N. Yang for their suggestion that parity is not conserved in weak interactions.

Another interesting item about Fermilab is its prairie restoration project: the return of the flora and fauna native to Illinois before the coming of Europeans to the area. This includes a herd of buffalo. They are interesting to watch, though I have not yet found the courage to touch one. One operator tried to ride one just to see if he could do it, but the grounds police stopped him while I pretended not to know that particular fellow operator.

The accelerator proper is a most ingenious machine. It all begins in the pre-accelerator, known as "pre-acc." In a Cockcroft-Walton generator, single electrons are added to hydrogen atoms, so that each becomes negatively charged. They emerge from pre-acc with an energy of 750 keV.

The ionized hydrogen atoms then enter a 500-foot-long linear accelerator, the "linac." This machine creates oscillating electric fields analogous to ocean waves. The negative hydrogen ions ride these waves like surfers and are accelerated to 200 MeV.

The ions next enter a "booster," a synchrotron approximately 500 feet in diameter, where the ions are stripped of their electrons and then accelerated to 8 GeV.

The protons are then transferred to the main ring, approximately four miles in circumference. Actually there are two main rings, one above the other. The top ring uses conventional magnets. Protons enter it from the the booster and are accelerated, through radio-frequency cavities, to 150 GeV. Then they are injected into the lower ring, the Tevatron, which has one thousand superconducting magnets. Imagine a four-mile long pipe carrying helium at just two degrees above absolute zero!

From the Tevatron the protons have two possible paths. In the Collider-Beam mode, they bombard a fixed rhenium-copper target, where antiprotons are produced and accumulated. The antiprotons are injected back into the main ring, and then into the Tevatron, in three bunches, all moving counterclockwise as viewed from above. Meanwhile, three bunches of protons are injected into the machine. The positively charged protons circulate clockwise. As the bunches pass through each other, a few protons collide with their antiparticles, and the resulting showers of debris are collected and analyzed in the Collision Detector Facility. Now at first glance it may seem that there are many collisions, but that is not the case. Each bunch of protons or antiprotons has only about 10^{10} particles, compared with 10^{19} in a cubic centimeter of air, so we are dealing with relatively small numbers.

In the Fixed-Target mode, the protons are injected from the Tevatron into the "switchyard", which is just what it sounds like. Magnetic fields are used to send the beams into any of three large areas--meson, neutrino, or proton--and then into specific experimenters' detectors within these areas.

This has been only a quick sketch; there is much more that one could write about Fermilab. The main theme of many of the current experiments is the testing of the quark theory. At present, most evidence appears to favor the "standard model."

Lastly, I would like to point out that during my interview, all the people I talked with made it a point to ask, "Okay, forget all about your degree, and let's get down to basics: WHAT CAN YOU DO?" They were very impressed that I had acquired experience with many types of equipment. SSU's philosophy of "hands-on" experience at the undergraduate level, I am discovering, is quite unique and valuable. I cannot help but believe that it was this experience, mainly, that opened my way into Fermilab.