THE PHYSICS MAJOR

A Vintage Year

This is a vintage year for Sonoma State University's Department of Physics and Astronomy, according to Professor Joseph Tenn, advisor to all physics majors. "In 1990 we expect to have nineteen graduates," he reports. "The current record for one calendar year is eighteen, set in 1975."

It also appears that this year will see a record number of graduates going on to graduate school. Seven of the 1990 grads intend to pursue advanced degrees, and all seven have been awarded fellowships, teaching assistantships, or research assistantships that will pay their fees and living expenses in grad school.

While the achievements of the other twelve will appear in future newsletters, it is the graduate-school bound whose plans are final as we go to press. Their goals illustrate a few of the many opportunities available to physics graduates.

Alan D. Gering's degree was awarded in January, but he actually finished last summer. Since September he has been a graduate student and research assistant in biomedical engineering at the University of California, Davis. Currently working with thin films of diamond and diamond-like carbon, Alan writes that what he learned in Dr. Saeid Rahimi's semiconductor physics lab is useful now.

Since receiving his degree in January with a double major in physics and applied mathematics, **René Woolcott, Jr.** has continued research in solid state physics with Dr. Rahimi. The two have been using photo-induced transient spectroscopy to investigate the properties of gallium

continued on p. 9

Sun Workstations Arrive

Two Sun workstations are now available for use by the students and faculty in the SSU Department of Physics and Astronomy. Sun workstations are high speed, graphics oriented computers which run the UNIX operating system. The first to arrive was a Sun 3/60, complete with a 337 megabyte disk drive and a $^1/_4$- inch tape drive. This machine was obtained as a result of a proposal, written by Dr. Lynn Cominsky, which was selected in a campus-wide competition for a donation from Sun Microsystems. The machine, which also has a 19-inch color monitor with approximately one million pixels, is used by students in Dr. Cominsky's signal processing course and Dr. Spear's new image processing in astronomy course, to be offered again in Fall 1990. Software installed includes Image Reduction Analysis Facility (IRAF), developed for use by the Hubble Space Telescope, which can also be used to analyze data from the SSU Observatory's CCD camera. Named Charmian, after Jack London's famous wife, the Sun is located in Darwin 329, and is available for use by any physics major.

The second Sun workstation is the latest model, a Sparcstation 1. Obtained with Dr. Cominsky's latest NASA grant, it has a 16-inch color monitor and 900 megabytes of hard disk storage. Although this computer will be used primarily to support Dr. Cominsky's research on X-ray pulsars, it is networked to Charmian, and the two machines can share disk space. Installed in Dr. Cominsky's office, it is called Luther, after another famous Sonoma county resident, Luther Burbank.

Yet Another Great Year for SPS

Susan Osborn (née Knaus)

The SSU chapter of the Society of Physics Students (SPS) had yet another active year. The Tuesday lunch hour lecture and film series was continued, and the activities spilled over into Sunday afternoon study breaks as well. There were more volleyball picnics, and the annual beach party tradition continued.

The year started off with a new member orientation and election of officers foodfest. SPS President Tim Silver's spaghetti with pesto sauce was the highlight of the food-for-all.

The lunch-time lecture series then quickly got underway. SSU chemistry graduate Steve Trocha discussed his work at the University of California, San Francisco in the CAT scan medical field. Dr. Joe Tenn's talk on getting into graduate school was voted most informative by SPS Secretary and Treasurer Marie-Christine Raude-Rozet. Physics senior Joe Beasley gave a slide show and discussion of his summer '89 internship with the Langmuir Lab for Atmospheric Research at the New Mexico Institute of Mining & Technology. Joe's internship involved investigation of the electric charge buildup of thunderclouds. Former SPS President Francis Moraes wrapped up the lecture series with a double hitter, describing his research with Dr. Lynn Cominsky on a binary pulsar and also presenting a model of NO_2 buildup he has been studying in preparation for his graduate work in atmospheric physics next year.

The lunchtime film series included NASA films on exploration of the planet Mercury and the Apollo 17 moon landing. The latter featured humorous footage of the astronauts kangaroo-hopping along the lunar surface in an attempt to maintain balance with their heavy life-support equipment. The last two films were of a more relaxation-promoting nature and were the second best attended events of the year. SPS President Amanda Tunison graciously provided two oft-requested Star Trek videos from her private collection. "The Trouble With Tribbles" was voted most endearing, and "A Piece of the Action" was voted most out of Spock's character by Greg Davis and the popcorn-providing crew.

The Sunday study break activities centered around fun investigations of Newtonian physics. Vector theory was thoroughly investigated at the local miniature golf course. Jim Garrett was the undisputed winner of this hard-fought investigation. Friction studies at the local roller skating rink were so informative that Miriam Tobin has extended the investigation to Wednesday evenings. SPS members continued their practice of selling refreshments at the monthly Public Viewing Nights at the SSU Observatory. SPS members also were very involved in urging Darwin students to vote in the Associated Students elections this year and in contributing to the school paper *The Star*.

Social events of the club centered around pizza, hotdogs, chips, and drinks at lunch time volleyball picnics and the year-end beach party. In volleyball, Dr. Duncan Poland was unanimously voted best player. All that time on the basketball courts must be paying off, Duncan! The beach party was a huge athletic and culinary success, lasting from 10 in the morning until 9 at night. The highlight of the beach party was an entire nine-inning baseball game, starring pitcher Al Modeer, energetically played under sand-blasting wind conditions.

Another huge success was the sale of the SSU Physics T-shirts inspired by Jim Garrett's contest-winning design. If you haven't seen the shirts yet, the front panel sports artistic portraits of the seven physicists named on the back of the T-shirt. The names are arranged to spell PHYSICS vertically down the spine of the wearer. The shirt was so popular that both printings were immediately sold out. If you don't have your order in, you will have to urge the SPS of next year to do a third printing.

This is yet another SPS President signing off and thanking the SPS members and the Women of Darwin for a GREAT year.

THE PHYSICS MAJOR No. 15 May 1990

Published by
Department of Physics and Astronomy
Sonoma State University
Rohnert Park, CA 94928
(707) 664-2119

Edited by Joe Tenn and Joan Ghiglieri

Written by Philippe Argouarch, Miriam Carolin, Lynn Cominsky, John Dunning, Joan Ghiglieri, Susan Knaus, Francis Moraes, Duncan Poland, Saeid Rahimi, Gordon Spear, and Joe Tenn.

Alumnotes

JAMES L. HILL (BS, 6/71, physics) now teaches physics at Piner High School, Santa Rosa. He taught for eighteen years at Los Gatos High School after earning his teaching credential at SSU.

STEVE WILLIAMSON (BA, 6/73, physics) is a consultant for manufacturing companies implementing productivity improvement systems. He also teaches part-time in the SSU Department of Physics and Astronomy. Steve earned a Master of Arts in Teaching in physics at UCLA and an M.A. in psychology at SSU.

SSUO Astronomers Active

Miriam Carolin

Research at the Sonoma State University Observatory (SSUO) has received two recent boosts: the acquisition and development of a charge-coupled device (CCD) image processing system and a $5000 research grant.

The CCD system is such an efficient light detector that an image which would require up to thirty minutes to record on a photographic emulsion can be obtained in one or two minutes. Thus far more data can be obtained in a night of observing. The system converts incoming photons into electrons which are counted electronically and recorded digitally. The astronomer takes an image from the observatory on a floppy disk. The image can be manipulated, enlarged, rotated, even subtracted from another image, in the basement laboratory of Darwin Hall.

The grant, awarded to Dr. Gordon Spear from a California State University program to encourage faculty research, is paying students Martha Eckert and Greg Keys to work on SSUO research programs and to develop software for image analysis.

Dr. Spear, his students, and former students are currently working on four major projects.

The first is the search for and discovery of variable stars in the region of the Galaxy opposite its center. During the winter of 1889-90 when this region (in Taurus, Gemini, Orion, and Auriga) was in the night sky, some fifty previously undiscovered variable stars were found by the SSU observers.

The active galaxy program has been underway since shortly after the establishment of the SSUO in 1976. It consists of long-term surveillance of the nuclei of several active galaxies. No one knows why these galaxies vary so much, but the process is believed to be similar to that which causes variability in quasars. The astronomers hope that extended study will provide some insight into the phenomenon.

A third project is the study of certain variable stars called Cepheids in the Galaxy. The graph of brightness as a function of time is called a light curve. Former student John Dotta, now a Petaluma teacher, has been observing the star KP Cygni and analyzing its light curve. This star, and the others studied, are believed to be Cepheids of Population II, older stars which formed before the interstellar matter had been enriched with elements formed in stellar interiors. Such stars are significant, in part because the Cepheid variable stars found in other galaxies are Population II, and nearer ones are needed to make comparisons. The two types of Cepheids have different light curves.

The last project does not require staying out late. Miriam Carolin and Joseph Beasley have been monitoring the activity of the Sun on a regular basis for some time. Each week they observe the Sun through filters and sketch what they see. One drawing depicts the spots visible on the face of the Sun; the other shows such active areas as prominences, filaments, plage areas, and faculae. The latter drawing is made with the aid of a hydrogen alpha (Hα) filter, which transmits only light of wavelength very near the bright red 6562.8 angström spectral line of hydrogen. One finding is that a large number of sunspots is not necessarily accompanied by a large number of prominences; another is that the current sunspot maximum is likely to be the most intense on record.

All four research programs will continue indefinitely. Most of the current observations have been made by veteran observers Miriam Carolin, John Dotta, and Chris Espenlaub, while much of the data analysis has been done by computer science student Martha Eckert. Dr. Spear is currently seeking new observers. Anyone interested in obtaining experience in astronomical observation or analysis is encouraged to join in the efforts to obtain a deeper understanding of the universe.

Faculty Meritorious

Each year since 1985 the California State University system has awarded $2500 prizes for Meritorious Performance and Professional Promise to approximately one-twelfth of its faculty. In 1989 the Department of Physics and Astronomy was the only department at Sonoma State University to have its faculty win three of the university's thirty-five prizes. Professors Lynn Cominsky, Duncan Poland, and Saeid Rahimi were honored.

The 1990 prizes were just announced, and once again the Department has three winners; this time it's Professors Lynn Cominsky, John Dunning, and Joseph Tenn. The Department's faculty have now won a total of fourteen MPPP awards in six years, not bad for a department with just seven permanent professors.

Timing Muons

Francis Moraes

The main requirement that distinguishes the bachelor of science in physics with a concentration in applied physics from the regular B.S. is the senior design project. My project involved the automation of an experiment that measures the mean life of cosmic ray muons on the surface of the earth. The purpose of the experiment is to measure the time for each muon to decay after it stops in a tank of scintillation fluid. The mean time is determined simply by averaging the times for the individual decays. With the use of some analog and digital circuits that I designed I have allowed the computer to do the experiment. The experiment has been greatly optimized and what used to take twenty hours of data collection now takes only one. In addition, the computer is able to output the mean lifetime and the lifetime distribution when the data-taking is complete or even (though I won't implement this) to give the results on data taken up to the current time without stopping the data-taking.

Other senior design projects: Nancy Kunnari built a light harp which delighted many attendees at the popular Science Night in November. The light harp consisted of a laser beam which was split into eight separate diverging beams using a grating. Each beam was then focussed onto a separate photo-detector, whose output was inverted, amplified and wired to a key of the Department's musical synthesizer. Breaking a light beam with a finger or chalk dust sounds the corresponding musical note.

Greg Davis is building a photo-diode array which will be used to detect alternating patterns of light and dark which result from the interference of two laser beams. Each photodiode is connected to an optical fiber, and the outputs are read into a Mac II computer, where they can be displayed as a simple image.

Rahimi Writing Text

This year Dr. Saeid Rahimi became the first member of the Sonoma State University faculty to win a one-semester research leave. With no teaching duties this spring he has been able to devote full time to research and writing. His main endeavor is a text for the semiconductor physics course he has developed since coming to SSU in 1982.

The basic principles and theory of semiconductor materials are introduced in the first part of *Physics of Semiconductors: An Introduction to Theory and Experiment*. The second part describes a number of experiments for characterization of semiconducting materials. Written for advanced undergraduate students of physics, materials science, and electrical engineering, it will be the first text to combine theory and lab manual in one book.

To obtain the latest information on experimental methods employed in the characterization of semiconductors, Dr. Rahimi attended a week-long workshop at Arizona State University in March. The workshop, given by three of the leading experts in the field, proved to be a valuable experience which will reflect both in Dr. Rahimi's book and his course.

In June Dr. Rahimi will attend another workshop. This one, sponsored by the National Science Foundation, will be at the University of New Mexico and will cover semiconductor optoelectronics. This is an intensive program for integrating the science and technology of optoelectronic materials and devices into the undergraduate curriculum. Dr. Rahimi was one of twenty-five faculty selected from more than eighty applicants to participate in the workshop; he plans to implement some of the ideas and experiments discussed in his course.

A by-product of the book effort will be a series of articles on individual experiments or instruments. "Controlling the Temperature of Solid Samples," coauthored with student René Woolcott, Jr. and technician Vern Schuck, will appear in 1991 in the *American Journal of Physics*.

Astronomers Portrayed

Dr. Joseph Tenn's photographic exhibit of the 82 astronomers awarded the Astronomical Society of the Pacific's Bruce medal was a hit at the Society's centennial meeting last summer. Assembled at Sonoma State University with the aid of student Miriam Tobin, the exhibit included photographs collected from ten countries and mounted with short biographical captions.

Now Dr. Tenn has begun writing longer biographies for publication with the photographs in the A.S.P.'s magazine, *Mercury*. Articles on 19th century astronomers Simon Newcomb, Arthur Auwers, and David Gill have already appeared, beginning in the Jan/Feb 1990 issue.

Since the magazine comes out six times a year, and one new medal is awarded each year, Dr. Tenn figures that he will be caught up with the issue of Mar/Apr 2006.

Donors Enhance Programs

Duncan Poland, Chairman
Department of Physics and Astronomy

Donations to Sonoma State University by alumni and community benefactors have significantly increased, enhancing university programs by augmenting state support with funds free of state bureaucratic regulations.

Last year the Ernest L. and Ruth W. Finley Foundation donated $250,000 to endow scholarships for students in the schools of Natural Sciences and Business & Economics. Sixteen science students are among those awarded scholarship from this fund for 1990-91.

This year the University received its largest donation to date in the form of a challenge grant of $3 million from the Ruth and Evert B. Person Foundation. Interest on the grant will enhance the Theatre Arts and Music programs at SSU, now using the new theatre building named for former *Press Democrat* publisher Evert Person. Gifts to *any* of the *endowed* funds on campus will count toward the required match.

Last fall the Department of Physics and Astronomy made its first solicitation of funds to support the "What Physicists Do" public lecture series and the Public Viewing Nights. The response has been very gratifying. Private contributions allowed us to bring to the spring series Neptune expert Heidi Hammel from JPL in Pasadena, atmospheric physicist Aslam Khalil from the Oregon Graduate Institute, and distinguished physicist and historian of photography Heinz Henisch from Pennsylvania State University. This spring we also heard noted physicist Max Dresden and 1988 Nobel laureate Melvin Schwartz, the eighth Nobel prize winner to speak in the series. These, and the other speakers this year, gave stimulating lectures that touched the interests of everyone in our diverse audience. Some funds have been used to improve the Public Viewing Night activities which continue to attract standing room only crowds. (Yes, the *only* room is standing room.)

The Department has also received donated funds for equipment and supplies. This money will permit the Department to respond to exceptional buying opportunities or sudden equipment failures and to augment state allocations when necessary for a specific purchase. The student-directed radio telescope project also has been aided by donations.

There are two scholarship funds specifically earmarked for physics majors.

Should the news of these donations stimulate you to send money to further enhance the quality of our activities, you can send a check to the SSU Academic Foundation, indicating that you would like it to go into an endowment account or to one of the discretionary accounts to benefit Physics and Astronomy.

Surplus equipment valued at $62,000 has been received this year from Hewlett Packard's Network Measurements and Signal Analysis Divisions, IBM, and Everex Systems.

Tim Kimball Wins Hawaiian Summer

Sonoma State University physics major Timothy Kimball has found the ideal summer job: astronomy research at the University of Hawaii. Selected to work with astronomer Charles Lindsey at the University's Institute for Astronomy, Tim will participate in infrared and radio observations of the Sun with the James Clerk Maxwell Telescope. This new 15-meter submillimeter and millimeter wavelength telescope on Mauna Kea was built by the British and Dutch governments, but University of Hawaii astronomers receive a portion of the observing time in return for providing local support.

Tim feels well-prepared for astronomy research. This year he has taken courses in scientific computing, astrophysics, and signal-processing, as well as analytical mechanics, electricity & magnetism, and optics. Currently working on Dr. Spear's search for new variable stars, he has become quite adept at using the astronomer's principal tool, the computer.

On return to SSU in the fall Tim expects to have a better idea of what research is like and what his specialty will be in graduate school.

Alumnotes

ROY SKINNER, JR. (BA, 6/74, physics) is the owner of a computer-based publishing business and a video production and distribution company in Pioneer, California. He is a licensed realtor and building contractor.

R. GARY WONG (BA, 5/75, physics) earned a Doctor of Chiropractic degree from Palmer College of Chiropractic-West in 1981. Board eligible in chiropractic orthopedics since 1989, he now practices in Santa Rosa.

PIERCE TIMBERLAKE (BA, 6/76, physics and philosophy) is now a technical writer for Island Graphics, San Rafael.

DENNIS GOODROW (BS, 1/78, physics) is the lead designer at Einstein & Goodrow, a software development company in Beverly Hills. He produces computer language translators, terminal emulators, and development tools.

Astronomers Talk to ANBS

Each spring brings a meeting of the Association of North Bay Scientists, with students and faculty from many institutions presenting research results in all of the sciences. The tenth meeting was held at Santa Rosa Junior College 28 April 1990 and featured four astronomy presentations from the SSU Department of Physics and Astronomy.

Michael Higgins described–and illustrated via videotape–computer simulations of galactic spiral arm development. Martha Eckert demonstrated the SSU Observatory Image Processing System (IPS). She, Dr. Gordon Spear, and others have developed software to do digital filtering and histogram modification, to add pseudocolor, and to derive positions, shapes, and magnitudes of objects in digital images.

Dr. Gordon Spear described the SSU Observatory variable star survey. He and his students, using the cooled charge-coupled device (CCD) at the telescope and the IPS for data analysis, have discovered a number of new variable stars in a region of the Galaxy not previously surveyed to such depth. Dr. Joseph Tenn presented an illustrated talk on astronomy a century ago.

Microprocessor Lab Updated

This spring semester, with the help of a $5625 California State University Instructional Development Technology Grant, Dr. Lynn Cominsky has redesigned the microprocessor applications laboratory. The course, formerly based on the Apple IIe and 6502 assembly language, is now taught in the Mac II lab with students using the MacForthPlus language to control devices interfaced to the Mac through the serial port. Experiments have been performed with thermistors, function generators, and light detectors. Students have built a circuit to convert the serial data coming from the Mac to parallel data with seven separate output signals. This allows the serial signal to control different relays or devices. At the same time, data can be obtained from measuring devices such as thermistors.

The output of the measuring device is read by the meter and then sent to the computer to influence what happens to the experiment. For example, the computer will read in resistance from a thermistor, compute temperature, and use that temperature to decide whether or not to turn on a heater.

An important part of the course is the project: each student must design and build a crude prototype. A more complicated version, called the virtual project, which the students design but do not build, has long been part of the lecture course. Now it is possible for each student to build parts of the virtual project in the lab. The nature of the project is up to the individual student, but each must interface a microcomputer to an experimental setup, and use the system to take data and/or control the experiment. This year students have chosen to computerize experiments from the solid state and laser labs, to build computer-controlled robots, to build a machine that senses dreaming and attempts to influence dreams by changing the sensory environment, to computerize a soil dialysis experiment, to build a photo-diode array using fiber optics which can send images to the computer, and to build an infrared remote controller for a digital stereo system. Several of these projects will be built to completion as senior design projects by students who wish to obtain the B.S. in physics with a concentration in applied physics.

Alumnotes

ALAN DEMARS (BA, 6/78, physics) is a senior communications systems software engineer working on microprocessor applications for communication satellites at COMTEL, Inc., Santa Maria. He received his master's degree in scientific instrumentation at the University of California, Santa Barbara in 1980.

JOHANNES RAAB (BS, 6/79, physics) earned a Ph.D. in experimental particle physics at the University of California, Santa Barbara in 1987. He is now doing research at CERN in Geneva.

RICHARD K. DEFREEZ (BS, 1/80, physics) is now an associate professor in the department of applied physics and electrical engineering at the Oregon Graduate Institute of Science & Technology, where he earned his Ph.D. in applied physics in 1985.

RICK KAMEN (BA, 6/80, physics) is teaching electronics, mathematics, and physics for the San Diego Community College District.

RICHARD MONTGOMERY (BA, 1/81, physics and mathematics) has accepted a faculty position at the University of California, Santa Cruz, beginning July 1990. Since earning his Ph.D. in mathematics at the University of California at Berkeley in 1986, he has conducted research at the University of California at Berkeley, the Massachusetts Institute of Technology, and the Mathematical Sciences Research Institute at Berkeley.

KITTY CHELTON (BA, 6/81, physics and biology) earned an M.S. in biophysics at the University of California, Davis in 1985. She also has an M.A. in psychology from Sierra University and is now an intern working on a Marriage, Family, and Child Counseling license at the Lomi Community Clinic, Santa Rosa.

The First Z at SLAC

Philippe Argouarch, BS, '88

On a Sunday afternoon in April 1989, Stanford Linear Accelerator Center Director Burton Richter burst into the main control room just when the huge machine started to go like popcorn. The heat wave hitting northern California that week looked like a last stroke to a collider already a few years behind schedule.

Many of the microcomputers in the klystron gallery were reaching the critical 50°C above which they would automatically shut down. When power supplies started to crash, it was decided to turn off the accelerator. An accelerator with thousands of magnets, 240 klystron amplifiers, and their associated instrumentation usually takes days, sometimes weeks, to restart. Something often dies during the reboot. And then there is the delicate triggering of kicker magnets, modulators, and the electron gun itself which never comes back exactly the same (at least at the picosecond level).

Well, after many years of hardship and frustration, the Stanford Linear Collider suddenly started to behave. Two hours after shutdown, the machine was restarted, and the beams were ready for collision in just twenty minutes! It was hard to believe.

The next day was spent fine-tuning the final focus and lowering the background noise coming from stray particles, mainly muons, generated before the interaction point when the beams, or rather some unwanted tails, hit the wall of slits and collimators. Then at last, in the early morning of Tuesday, April 11, we detected our first Z. This now-famous particle (first discovered in 1983 at CERN) carrying one of the four fundamental forces (the weak force of nuclear beta decay) had been spotted by the SLAC Mark II detector. Both electron and positron beams were at approximately 46 GeV. Since then we have observed hundreds of Z decays, as we improved the machine efficiency during the summer shutdown.

Soon the control room was full of television and news reporters trying to transform high energy physics into showbiz and the physicists into new age superstars. In fact, as we all know, there is no center stage in physics but a lot of hard work, mostly behind the scenes, often at night, with a lot of teamwork.

I have been working at SLAC for more than a year now, as an accelerator systems operator, and I feel very lucky to be a part of the discovery process. The machine itself is a challenge because of the many layers of complexity added over the years with each physics experiment and the budget constraints for the SLC (Stanford Linear Collider).

Electrical fields are used to accelerate particles; magnetic fields steer and also focus. Things look pretty straightforward at first; the complications arise mostly from side effects like beam dispersion, beam loading, beam coupling, jitters, wake fields, emittance, synchrotron radiation, and background noise.

Most of the collider is controlled by a Vax 8800 computer, with terminals and instrumentation concentrated in a control room. We keep the room dark to see the 140 CRT's better. And to keep people away! The only light we want is the one at the interaction point, where the luminosity has been increasing steadily to reach a plateau of 12-15 Z's per day.

At this moment the collider is being upgraded with a vertex detector to observe decay of uncharged particles, and we are going to start using a laser gun to polarize our electron source. It is thought that some very interesting physics can be done if the electrons' spins are aligned in the same direction and if this direction is known before collision. Perhaps I'll have more news next year!

Alumnotes

CLAUDE PLYMATE (BA, 6/81, physics) is an instrument observing associate working with the Fourier transform spectrometer on the McMath Solar Telescope of the National Solar Observatory in Arizona.

MARY C. SILBER (BS, 8/81, physics) received her Ph.D. in physics at the University of California at Berkeley in 1989 and accepted a postdoctoral position in the Institute for Mathematics and Its Applications at the University of Minnesota, where she is working in nonlinear dynamics.

KEITH BRISTER (BS, 6/82, physics) writes, "In the past year I've bought a new car, gotten married, taken a permanent job, and have bought a house. I expect that things will slow down a little after the baby is born in the fall." Now a staff scientist at the Cornell High Energy Synchrotron Source, he received a Ph.D. in applied physics at Cornell in 1989.

MIRIAM CAROLIN (BA, 6/82, physics) has just completed work for an M.A. in history at Sonoma State University. A history graduate of the University of Cincinnati before she came to SSU, she wrote her thesis on astronomer Heber D. Curtis. She continues to conduct research in astronomy at the SSU Observatory.

PETER SIECK (BS, 6/82, physics and applied mathematics) is now a research scientist with Airco Coating Technology in Concord.

Radio Telescope Project Update

Joan Ghiglieri

The SSU radio telescope group has been testing the hardware components of the single 3-meter dish system by observing the Sun. Phase II of the project will be completed when the second dish is tested and brought on line.

This year the detectors have been tested and calibrated at Hewlett-Packard by design engineers Bruce Erickson and Clyde Underwood and SSU physics student Joe Beasley. The detectors are mounted on the focal arms of each dish where they are tuned to collect incoming 21 cm (1440 Mhz) radiation.

The system receiver which amplifies the signal and converts it to DC voltage is functioning beautifully after undergoing testing and minor repairs at Hewlett-Packard by Stan Bischof with assistance from project coordinator Joan Ghiglieri and SSU physics graduate Lauren Novatne, currently an HP technician.

Steve Wallace is building computer-controlled motor assemblies for moving the dishes. Al Modeer and Paul Somerville have run low-loss coaxial cable through electrical conduit from the mounts on the ends of the Darwin roof to the control shack which houses the receiver and computer for the system.

The first phase in the alignment of the interferometer system has been completed. Miriam Tobin and Joan Ghiglieri mechanically aligned the mounts by determining a north-south line through the center of each.

An interferometer is simply a system of two or more dishes, separated by some baseline (in our case, the 300 ft long Darwin roof), and electronically linked. With the single dish telescope we can only detect the presence of radio waves from one direction at any given instant. When the interferometer system is operational we will be able to "see" interference fringe patterns which, with a powerful computer like the Sun workstation, we can reduce to produce actual images (radiographs) of the celestial source under observation. So for you students out there who want to experience the rewards (and frustrations) of hands-on science, exciting things will be happening on the project next year. Newcomers are always welcome!

Special appreciation is extended to the engineers at Hewlett-Packard as well as to our own faculty advisor, Dr. Lynn Cominsky.

Alumnotes

JAMES EYER (BA, 1/83, physics and management) is a program analyst in advanced energy systems research and development for PG&E in San Ramon. Formerly a technology marketing analyst with Alternate Energy Systems, Oakland, he earned an M.A. in management at SSU in 1986.

WILLIAM TOMLINSON (BA, 1/83, physics) is a student in the M.B.A. program at SSU and also working at Earth in Upheaval, Sebastopol.

DANIEL O'DONNELL (BA, 6/83, physics) is an independent photographer and writer in Los Angeles. His work has appeared in the *Los Angeles Times* and other publications.

STEPHANIE SNEDDEN (BS, 6/83, physics) is data analysis manager at Charter Data Processing, Santa Rosa. Currently teaching part-time in the SSU Department of Physics and Astronomy, she has also been an engineer at Optical Coating Laboratory, Inc. and an instructor of Take Nami Do.

DAVID LAPP (BA, 6/84, physics) will lead a delegation of American science students to the Soviet Union with the People to People program this summer. After four years teaching physics at Conant High School in Hoffman Estates, Illinois, he plans to return to California next year. He will receive his M.S. in physics from DePaul University in June 1990. He earned his credential at SSU in 1986.

TOMAS VERA (BS, 6/84, physics) recently completed a term as an officer in the U.S. Navy and accepted a position with Cal-Test, Inc. in Napa. The Veras expect their first child soon.

BRENTON WHITE (BA, 6/84, physics) is a program manager with Hewlett-Packard in Rohnert Park.

DENISE PAQUETTE (BS, 1/85, physics) is a senior satellite operations engineer with Lockheed Technical Operations Corp., Sunnyvale.

KEYVAN FARAHANI (BS, 6/85, physics) is a graduate student researcher in magnetic resonance imaging in the radiological sciences department at UCLA. He received his M.S. in biomedical physics at UCLA in 1989.

RONALD SIEROCINSKI (BS, 6/85, physics) is working on a Ph.D. in chemical engineering at the University of New Mexico. His research is on the kinetics of a radio frequency discharge for etching substrates. He received his M.S. in physics in 1988 at San Francisco State University.

'90 a Vintage Year

continued from p. 1

arsenide, an alloy that is starting to replace silicon in computer chips.

Last year a weekend of intensive work on an air traffic optimization problem won René and a math student an honorable mention in an international mathematical modeling contest.

Offered assistantships by six universities, René visited five before accepting a research assistantship in the materials science department at North Carolina State. For his doctoral research he plans to work on thin films that are superconductors at high temperatures.

"The biggest benefit of Sonoma State has been the close working relationship with the faculty, and the ability to do hands-on work," says René. "I believe my lab experience was important to the grad schools. Although this is not primarily a research institution, a person who wants to can get excellent research experience."

Nancy Kùnnari is also interested in materials. Her work for a local microwave company (where she has worked full time throughout her studies at SSU) combined with what she learned in such courses as the semiconductor lab led her to a very specific idea as to what she would pursue in grad school: why materials fail. After studying graduate programs she decided that the physics department at Iowa State University and the materials science department at the University of Minnesota came closest to her ideal. Both offered her fellowships and assistantships, so she visited them in March. Her choice became known when she returned wearing a Minnesota T-shirt. Apparently graduate school will not provide enough to keep Nancy busy in the fall. She and her husband are expecting their first child in November.

The intimacy of the Physics and Astronomy Department at Sonoma State University appeals to many of its majors. When asked why he chose to complete his B.S. in physics at SSU, **Francis Moraes** responded, "I liked the small physics classes." A graduate of Rancho Cotate High School, he did his lower division work at Santa Rosa Junior College before entering SSU three years ago.

Experienced in the ways of research after two years of working on pulsars with Dr. Lynn Cominsky, Francis searched the scientific literature for the right person working on his interest–global modeling of the atmosphere–before settling on Dr. Aslam Khalil at the Oregon Graduate Institute of Science & Technology. He returned from a January visit to Oregon with such enthusiasm that Dr. Tenn invited Khalil to speak in the "What Physicists Do" series this spring. Now the whole department has heard about the exciting and important work Francis will be part of as he pursues a Ph.D. in atmospheric physics.

Fausto Morales heard about Sonoma State at an American school in Switzerland. A native of Spain, he had played competitive chess since high school, but wanted to resume his education. Proficient in Spanish, French, and English, he had considered becoming a translator. Then a book on cosmology and particle physics so impressed him that he decided to study physics. Aside from one semester of chemistry and calculus, he has completed all of the work for a B.S. in physics in just three years at SSU.

"I feel privileged to have completed my undergraduate education at Sonoma State University," says Fausto, "because of the opportunities I have had to participate in activities outside of the classroom. I have computed star models and studied the diffusion equation in main sequence stars; I have tutored physics and served in the mentor program. The attention from the instructors has been what I hear others only receive in graduate school."

Fausto will pursue a Ph.D. in theoretical physics at the University of Michigan, where he has accepted a teaching assistantship.

Daniel Swearingen hasn't been seen on campus lately. Last year he moved to Los Angeles, where he has been finishing up his degree requirements at California State University, Northridge. This spring he is taking graduate courses in physics and already working as a research assistant. After receiving his degree from SSU, he will continue at CSUN for his master's degree.

Mieko Yoshida came to SSU from Japan after earning her B.A. in western philosophy. Although long interested in science, she had been unable to study it at her university. At Sonoma State she essentially started as a freshman again. Inspired by Dr. John Dunning's applied nuclear chemistry and physics courses, she has decided to specialize in dealing with high level nuclear wastes. She applied to a number of graduate programs in nuclear engineering and was welcomed by all. Three of the programs offered research assistantships, and after a visit, she selected the University of Florida, where she intends to earn a master's degree.

Alumnotes

GEORGE AMORINO (BS, 1/86, physics) has accepted a research assistantship and a training grant at Colorado State University and will begin studies there toward a Ph.D. in cellular and molecular radiobiology in Fall 1990. Since receiving his M.S. in biomedical engineering at CSU, Sacramento in 1988, he has been a research assistant in molecular physiology and biophysics at Vanderbilt University.

PETER ROONEY (BA, 6/86, physics) is a graduate student in physics at the University of California, San Diego, where he received his M.S. in 1987. He has been a teaching assistant and an IBM fellow.

DARITH PHAT (BA, 6/87, physics) is an assistant professor at École Centrale, Paris. He has almost completed a Ph.D. in bioengineering at the University of California, San Diego.

CHRISTOPHER RAY (BS, 6/87, physics and applied mathematics) is a graduate student in physics at the University of California, Davis. Formerly a teaching and research assistant, he has been awarded a fellowship for 1990-91.

CHRISTOPHER C. COOK (BS, 6/88, physics) is working in the quantum electronics group at the MIT Lincoln Laboratory in Lexington, Massachusetts. He is also a graduate student in electro-optics at Tufts University and a proud father.

KENNETH A. RITLEY (BS, 6/88, physics) is doing research full-time at Brookhaven National Laboratory while a graduate student in physics at the University of Massachusetts, Amherst. After taking his M.S. he will transfer to the Ph.D. program at the University of Illinois, where he has accepted a teaching assistantship for 1990-91.

LOU SANCHEZ-CHOPITEA (BS, 6/88, physics) is a control systems programmer at the Stanford Linear Accelerator Center. He has presented papers on the control system of the Stanford Linear Collider.

IAD MIRSHAD (BS, 1/89, physics) is a graduate student and teaching assistant in physics at the University of California, Davis.

LAUREN NOVATNE (BA, 1/89, physics) is a research and development technician with Hewlett-Packard Co.

KATHERINE RHODE (BA, 6/89, physics) is an associate programmer/analyst with ST Systems Corp. at NASA Goddard Space Flight Center, analyzing data from the Ultraviolet Imaging Telescope. She conducted astronomical research at the Maria Mitchell Observatory in Nantucket, Massachusetts last summer.

DANIEL WILCOX (BS, 6/89, physics) is a research associate at the Space Sciences Lab of the University of California at Berkeley.