

# The PHYSICS MAJOR



Sonoma State University • Department of Physics and Astronomy

## Anderson Wins Award

Students and faculty in the Department of Physics and Astronomy have long been aware that Steve Anderson is a very clever individual. Now the state of California has recognized this fact.

Last year the Department's technician was awarded the largest Employee Incentive Award ever given at SSU, the amount of the award based on the savings to the state.

Anderson proposed that the campus have a single master contract for the various gases used in such departments as art, kinesiology, and physics & astronomy. Under this contract, gas cylinders are delivered and the empty ones picked up for filling on a regular schedule at each building. Previously, each department had its own employee drive to Santa Rosa to pick up its own gas cylinders. Steve's idea now saves the university more than \$10,000 per year.

## Dunning on the Mend

Dr. John Dunning has been sighted thrice in Darwin Hall recently. Everyone is glad to see the popular teacher and director of the nuclear and X-ray labs coming in to plan some new experiments for the fall. Dr. Dunning has been home since January, recovering from heart surgery. Now that he is well enough to drive again we can expect to see him around more often.

Those who know him will not be surprised to learn that one of Dunning's recent visits was to measure his own radioactivity, induced by an injection of short half-life radioactive thallium for a medical test a few days before.

## On to Heidelberg

Scott and Sean Fraser

*Editor's note: Identical twins Scott and Sean Fraser came to SSU from Piner High School in Santa Rosa. After completing more than 200 units, one has perfect grades while the other has only a few A-'s to "mar" his transcript. Both were awarded prestigious \$7000 Barry Goldwater scholarships for next year.*

This semester ends our sixth year at SSU. One reason we've been here so long is that we are meeting all requirements for a BS in Physics and BA's in Math and English. It has also been hard to leave simply because SSU has been so much fun.

But we have left SSU for the past two summers to participate in Research Experience for Undergraduate programs. Last summer, at the Pennsylvania State University, we were fortunate enough to work on an interesting project about fundamental particle collisions. We used a computer to generate random momenta for interacting gluons, and then evaluated the probabilities that the interactions would occur. We learned a lot and had a fun introduction to graduate school in physics. We are planning to continue to work with our Penn State advisor this summer by e-mail and we hope to publish the results in a short paper.

The previous summer we participated in the REU program at the College of William and Mary, where we had the opportunity to learn something about fluid mechanics and X-ray tomography, and we also got to see historic Williamsburg.

Some people are surprised that we have taken all of the same courses and were accepted to the same REU programs. In the first case, can we help it if we have the same interests? In the second case, perhaps it's luck, since not everything we do is the same. We received the quite different scores of 1 and 11 on this year's Putnam Exam in mathematics (the reverse, oddly enough, of our scores last year).

We were pleasantly surprised to have each received a Goldwater Scholarship for the 1994-95 year. We will graduate after spending them (the year and the scholarship) at the University of Heidelberg in Germany through the California State University International Program, where we will concentrate on math and German. After that, we are both interested in attending graduate school in theoretical physics and learning about general relativity, quantum electrodynamics and quantum chromodynamics; it would be nice to take an introductory course in elementary particles in Germany if time permits. We hope the professors in Heidelberg are as inspiring as the ones we've had here!

## Alumni Gather

Mark Robinson ('93)

SSU physics alumni had so much fun at the reunion last fall that they are planning another gathering in fall 1994. Many of the alumni thought that it would be fun to socialize with the current students; this inspired them to think of a joint alumni-SPS picnic and volleyball game. The date has yet to be set, but alumni should look for a flier in the mail this summer.

## What I Did on My Sabbatical Leave

Lynn Cominsky

During the past year, I have been on sabbatical at the Stanford Linear Accelerator Center, working with the Particle Astrophysics group. This group was started by Prof. Elliott Bloom, to investigate high-energy emission in X-rays and gamma-rays from black holes and neutron stars using space-borne instruments. I have been helping them to design a new instrument called GRSST, Gamma-Ray Silicon Strip Telescope, for which we hope to receive funding from the Department of Energy. This device uses many layers of solid state silicon detectors to track the paths of electron-positron pairs which are produced when a gamma-ray enters some high-Z material at the top of the stack. After the pair-conversion event, the electrons and positrons travel down through the silicon until they are absorbed at the bottom of the stack by a CsI calorimeter, which measures the deposited energy. By following the tracks backward, the direction of the incident photon can be derived, so that the detector acts like a telescope to make crude images of the high-energy (20 MeV - 50 GeV) gamma-ray sky. Objects that are visible with this type of telescope include pulsars, gamma-ray burst sources and active galactic nuclei.

I have also been working on developing a ground data analysis software system to analyze data from an experiment called USA (Unconventional Stellar Aspect), which will be launched in 1995 on the ARGOS Air Force satellite. This is a proportional counter X-ray astronomy experiment which will study the brightest neutron star and black hole binaries, for extended periods of time and at very high time-resolution. The group at SLAC built the mechanical collimators which define the field-of-view of the detectors, as well as some of the structural support for the experiment. They are also helping to write the flight software (which runs in computers inside the experiment.) This project is a collaboration with a group of scientists at the Naval Research Laboratory, who are refurbishing the proportional counters, which originally flew on the SPARTAN shuttle mission. The NRL is also integrating and testing the experiment, to make sure it is spaceworthy.

Some of my time at SLAC has been used to finish writing up the results of NASA-funded research that I have been doing at SSU over the past few years. Mallory Roberts has been assisting me in these efforts, and we have presented papers at meetings of the Astronomical Society of the Pacific and the American Astronomical Society. Recently, a paper of ours entitled "Detection of X-ray Emission from the PSR 1259-63/SS2883 Binary System" was accepted for publication in the June 1, 1994, issue of the *Astrophysical Journal*. In this paper, we report the unexpected detection of X-rays from a radio pulsar in a binary system which appeared unlikely to emit high-energy radiation. We have also worked on *Compton Gamma Ray Observatory* data from 4U0115+63, which is the pulsar I discovered when I was a graduate student at MIT.

Although I am looking forward to returning to teaching at SSU half-time in the fall, I will still continue to be associated with SLAC on a half-time basis throughout next year. Mallory will be attending graduate school at Stanford, so we may continue working together. I encourage any SSU students who are interested in participating in this type of research to contact me in the fall when I return to campus.

## Greene Seeing World

Dr. Sam Greene is on sabbatical leave this spring, traveling around the world. The last time he did so he brought back some great slides showing sites alleged to have been visited by extraterrestrials. None were convincing then, but we will have to wait 'til fall to see what he found this time.

### THE PHYSICS MAJOR No. 19 May 1994

Published by:

Department of Physics and Astronomy

Sonoma State University

Rohnert Park, CA 94928

(707) 664-2119 gayle.walker@sonoma.edu

Edited by Joe Tenn

Production Assistance by Mark Robinson

Written by Lisa Christensen, Lynn Cominsky, Scott

Fraser, Sean Fraser, Michael Fink, Jeff Kavanaugh,

Robert Lahaderne, Dave Lamb, Duncan Poland,

Mallory Roberts, Joe Tenn, and Amanda Tunison.

## Tenn Portrays Astronomers

Dr. Joe Tenn has been active in the modern history of astronomy this year. In June 1993 he presented an invited lecture, "The First Twenty Bruce Medalists," in the history session at the 105th meeting of the Astronomical Society of the Pacific (ASP) in San Diego. In January he gave an invited lecture on "Highlights of California Astronomy from the 1880s to the 1980s" to the American Association of Physics Teachers, also in San Diego. In February he organized and chaired a session on "How California Astronomers Changed Our View of the Universe" at the meeting of the American Association for the Advancement of Science in San Francisco. In June 1994 the ASP will meet in Flagstaff to celebrate the centennial of the Lowell Observatory. As chair of the ASP History Committee, Tenn has organized several history sessions, including one on the role of the Lowell Observatory in twentieth century astronomy. The 22nd of his series of biographical articles on medal-winning astronomers appears in the March/April issue of *Mercury*.

At the AAPT meeting, Tenn, Dr. Lynn Cominsky, and Dr. Gordon Spear presented a poster paper, "Yes, There Are Jobs in Astronomy." Some of the quotations from graduates displayed on these pages came from that paper.



## Upward and Onward

*Lisa Christensen ('94)*

Graduation day, May 27, 1994, is a time of transition in the lives of seven physics majors at SSU.

Jeff Kavanaugh has accepted a research assistantship from the department of geophysics at the University of British Columbia to study glaciology. He will begin his research this summer atop a glacier in the Yukon! Mallory Roberts has accepted a fellowship from Stanford University to pursue a Ph.D. in physics. He will start research in the particle astrophysics group at the Stanford Linear Accelerator Center (SLAC) during the summer before his first quarter. David Lamb has accepted an assistantship in the physics Ph.D. program at the University of Alabama at Huntsville, where he intends to study solid state physics or optics. Chuck Rogers will spend the summer as a camp counselor in the Appalachian Mountains. David Miller, who will graduate with a double major in physics and math, will be taking a break from the scholarly life to travel. He plans to enter a graduate program in 1995.

Ian Holland plans to "catch a ride on the information super highway," possibly working for a fiber optics company in the area. And Lisa Christensen will enter the Stanford Teacher Education Program (STEP) in June. This program will allow her to earn a Master of Arts in Education and a teaching credential in four quarters. Afterward she intends to teach physical sciences to high school students.

There were two graduates in January: Else Schmidt has since been promoted to engineer at Hewlett-Packard in Santa Rosa, and Suryadi Wijono is believed to have returned to Indonesia.

The physics program at SSU has proven to be excellent preparation for a myriad of life's paths. The students' success is due in part to the support and guidance of the faculty and staff in this department. Ultimately, however, success is achieved by the students, whose hard work and courage has made this graduation day something of which they can be proud.

## SPS Members Sighted Outside Darwin Hall

*Jeff Kavanaugh ('94)*

Tired of breathing the stale air inside Darwin Hall, the SSU chapter of the Society of Physics Students ventured outdoors for many of its events this year. President Jeff Kavanaugh, Vice President Mallory Roberts, Secretary Lisa Christensen, and Treasurer Rebecca Freeman led the motley crew of physics ruffians through the year's adventures.

A fall camping trip to Fort Ross kicked off the year, and members enjoyed hiking, playing football, and climbing the sea cliffs. The local rock climbing community was stunned by the high technical difficulty of the ascents. Spring outings included a hike at Point Reyes national seashore and a bonfire at Goat Rock. At the bonfire, Jorge Polanco created what is thought by the scientific community to be the most evenly burnt piece of wood yet created, though his research continues today.

Several other events were held outside Darwin Hall as well. An evening was spent at the local pub studying the behavior of bubbles in glasses of beer. Several members visited the SRJC Planetarium, and found that the warm room and comfy chairs provided a much better research environment than the cold SSU Observatory. Despite the cold, the Public Viewing Nights at the observatory provided the SPS with an opportunity to sell refreshments to fund the traditional end-of-semester parties.

The SPS also sponsored some talks this year, including an informal talk with SSU alum Dan Nottingham. Dan spoke about a wide range of topics, including his pioneering work on SSU's Very Small Array and of his current work with polarimeters. Our own Vice President Mallory Roberts gave weekly classes about the VSA and various aspects of radio astronomy in general. Dr. Joe Tenn presented his popular lecture on how to get into graduate school for 1995 and 1996 graduates at the last meeting. Despite member protests, these talks were held inside Darwin Hall.

## Life in the Credential Program

*Michael Fink ('93)*

For those physics students interested in teaching, rather than safer work such as nuclear testing, here is a brief glimpse of the credential program from the eyes of a physics graduate. I believe that I can speak for all three of the physics credential candidates when I say that education classes are very different from physics courses. We have mixed feelings about which is more relevant, interesting and difficult. I know that I had expected everything to seem easy after Dr. Joe Tenn's mechanics course.

There are many challenges in the education courses. A lot of the work is in the form of producing portfolios. A portfolio is a collection of stuff that gives evidence of what you can do and what you have learned. Despite my best planning, the three I have completed have turned into a mad dash to bring things together on the last night.

At first these portfolios seemed like a pointless effort. It was not until my first job interview, where I was asked to bring a portfolio with me, that I saw that the effort had more meaning than just a grade.

The classes themselves hold my interest about 50% of the time. There is a lot of reading to do and very little problem solving. My favorite class so far is content reading and writing taught by Dr. Martha Ruddell. This is the first course that goes into specific teaching techniques in a thorough and organized way.

The majority of "real" learning to teach takes place in my student teaching classroom. My master teacher, Paul Eiserich at Petaluma High School, has taught me a great deal about how to teach and what to teach. The secret is lots of hands-on experiments and interesting demonstrations.

Believe it or not, I find myself missing those long hours of solving physics problems. Unfortunately, these problems and their solutions have yet to come up in the 9th grade physical science I am teaching. I miss physics courses in the same way I miss high school. I remember the good times but I'd never go back.

## Donors Are Appreciated

This year a special appeal to those receiving the What Physicists Do and Public Viewing Night posters produced contributions from many new donors to the Physics & Astronomy Public Programs fund. Significant contributions to the Department's Supplies account have allowed the purchase of equipment to upgrade the lasers and holography laboratory. Privately funded scholarships have helped support several outstanding physics majors.

Donations to the Department are increasingly necessary, as the level of state support for public higher education is unlikely to return in the foreseeable future to that of a few years ago. California State University presidents have recently been directed by the CSU Trustees to raise at least 10% of their annual budgets from private sources!

### CURRENT ACCOUNTS

Physics and Astronomy accounts which can be used immediately are the Observatory Fund, Public Programs Fund, Radio Telescope Fund, Direct Scholarship Fund, and the Supplies Fund.

The Public Programs Fund supports Public Viewing Nights at the SSU Observatory and the What Physicists Do public lecture series. The series has brought nearly 600 speakers, including eight Nobel prize-winners, to the campus since 1971. It is now funded entirely by donations.

The Department Equipment account supports the purchase of new equipment for use in instructional laboratories. For the past two years there have been no state funds for the purchase of new equipment.

### ENDOWMENT ACCOUNTS

Income from the Physics and Astronomy Endowment Scholarship Fund and the Joseph S. Tenn Scholarship Fund provides scholarships for outstanding SSU Physics majors. Scholarships are awarded through the University Scholarship Program.

Income from the Science at Work Fund helps support the What Physicists Do public lecture series. The initial endowment contributed by John Max, of the MAX Machinery Company in Healdsburg, has been augmented periodically.

Contributions to any of these accounts may be sent to the Department Chairman, Duncan Poland, with a note designating for which fund(s) the donation is intended. Checks should be made out to the SSU Academic Foundation. All contributions are tax deductible to those who itemize. The Department thanks the following donors who have contributed since the last newsletter.

#### #63853 OBSERVATORY

None.

#### #63851 PUBLIC PROGRAMS

Robert & Lorene Abbey, Rohnert Park; Dolph Andrews, San Francisco; Paula Bordner, Bodega Bay; Richard & Iris Borg, Sea Ranch; Kelleen Boyer, Cotati; Bert Brians, Penngrrove; Leonard Bronstein, Santa Rosa; Charles &

Judith Buff, Santa Rosa; Ben & Zoe Burmester, Petaluma; Gene & Catherine Carrington, Vallejo; Theodore Chenoweth, Sonoma; Marvin Chester, Occidental; Malcolm & Alicia Chisholm, San Jose; Ruth Clary, Petaluma; Albert & Carol Cognata, Santa Rosa; Richard & Molly Cohen, Novato; Lynn R. Cominsky & Garrett Jernigan, SSU; Michael & Judith Cuchna, Merced; Arden Danekas, San Francisco; Charles Daymond, Cotati; Charles & Margaret Dexter, Santa Rosa; Richard Dixon, Suisun City; Fernando Dizon, Santa Rosa; Donald J. Farmer, Sebastopol; Dennis & Susan Fujita, Sebastopol; Joe & Shawna Gannon, Santa Rosa; Loretta Garcia, Cotati; Richard & Kent Gilbert, Santa Rosa; David Gillett, Mendocino; Will & Lee Gipple, Novato; Francis & Geraldine Halpern, Santa Rosa; Dale Houston, Petaluma; Mary R. Jensen, Petaluma; Brian & Carlene Keller, Sebastopol; Weston Kendall, Santa Rosa; William & Lucy Kortum, Petaluma; Jeffrey & Tina Kroot, San Anselmo; Robert & Dorothy Kuehnert, Vacaville; John Max, MAX Machinery Inc., Healdsburg; Ralph & Hilda Mansfield, Santa Rosa; Carl & Linda Marschall, Penngrrove; Francis V. Marshall, Petaluma; P. McDermott, Palm Desert; Kevin McDonnell, Petaluma; John & Shirley McGuire, Terra Bella; Charles & Norma McKinney, Windsor; Bernard H. Meyers, Novato; Kitty Miles, Napa; Mike Miller, Moon Valley Circuits; Jim & Melinda Moir, Santa Rosa; Moon Valley Circuits, Glen Ellen; Wilma J. Moore, Santa Rosa; Horace Newkirk, Santa Rosa; Evelyn Norton, Kelseyville; Vernon S. & Marilyn J. Piccinotti, Petaluma; Shepard Porter, Petaluma; Robert & Bertha Rains, Santa Rosa; Damon & Linda Rarey ('88), Santa Rosa; Gregory Rehberg, Berkeley; Arthur & Dorothy Roach, Santa Rosa; David Root, Santa Rosa; Greg & Linda Rose, Sonoma; Marguerite T. Ross, San Rafael; Julius Schindler, Novato; Alexander Sharp, Bodega; Raymond Skryja, Guerneville; Philip Sullivan, Occidental; Timothy & Shirley Sullivan, Santa Rosa; Robert Tuttle, Santa Rosa; Fredrick Veio, Clearlake.

#### #63850 RADIO TELESCOPE

None.

#### #85960 PHYSICS & ASTRONOMY SCHOLARSHIP (current). Joe & Eileen Tenn.

#### #63852 PHYSICS & ASTRONOMY SUPPLIES

Fred J. Aves, Yverdon Vineyards, St. Helena; Clinton & Julie Bruce, Cotati.

#### #75960 PHYSICS & ASTRONOMY SCHOLARSHIP (endowment). David H. & Paula D. Bennett ('86), Novato; Charles Carpenter ('88), California City; Lynn R. Cominsky & Garrett Jernigan, SSU; Duncan & Marion Poland, SSU; State Farm Insurance, Rohnert Park.

#### #77020 SCIENCE AT WORK

John Max, MAX Machinery Inc., Healdsburg; Joe & Eileen Tenn, SSU.

#### #78380 JOSEPH S. TENN SCHOLARSHIP

Michael W. McBride ('75), Rohnert Park; Mark Robinson ('93), Cotati; Daniel & Gail Tenn, Calabasas.



## Laser Lab Enlightens Students

*Dave Lamb ('94)*

With Dr. Sam Greene on sabbatical leave this spring, Dr. Saied Rahimi took over the department's course in lasers and holography. This was the first time Dr. Rahimi taught the course, and he was the first to admit that the class was a learning experience for himself as well as his students. The class rolled along smoothly with the help of Steve Anderson, who is somewhat of an expert in this field.

Enrollment was high with 14 students, but everyone was accommodated, and all participated fully in each of the six major laboratory exercises. The class was split into several groups of two and three students, each of which worked on a separate experiment for two weeks, after which time everyone switched to another experiment. Each of the six experiments emphasized a different aspect of either the physical workings of lasers (as in external mirror alignment) or laser applications (such as spectroscopy, interferometry, and fiber optics). Perhaps the most popular exercise among the students was the creation of holograms, which was as much of an introduction to film development as it was to interference phenomena. Extra time allowed a few of the students to study the acousto-optic effect, in which information produced by an acoustic signal is transported along an optical beam.

A diode laser lab was added to the curriculum as a result of Dr. Rahimi's sabbatical last year at Hewlett-Packard. In addition to being highly efficient, diode lasers can be made very small, with dimensions on the order of microns. The future is bright for diode lasers because such small devices can be integrated with an electronic circuit, and the output of the laser can be easily coupled to a fiber optic cable. The goal of our experiment was to determine some simple characteristics of our devices by measuring the threshold current at which the diode laser would lase.

This was a class that I had wanted to take ever since I saw the course description when I was in high school, and it was well worth the wait. In a fairly short amount of time we were able to learn the basics of how a laser can be used as a tool, and we had a bit of fun in the process. This was a course in a growing and exciting field, and the combined experiences of Dr. Rahimi and Steve Anderson contributed greatly to giving us a big picture of possible and probable future applications of lasers.

## So This is What We Do

*Robert Lahaderne*

This year the "What Physicists Do" public lecture series continued for its 46th and 47th successful semesters. Every Monday at 4:00 p.m. speakers from industry, national labs, and universities come to Sonoma State to speak on such exciting topics as geophysics, environmental health, and new approaches to gathering astronomical data. The coffee and cookies offered with a smile by Miriam Carolin ('82) at 3:30 allow us to meet and talk with the speakers about

companies, graduate schools, and current research. The lecture is the most relaxing time of the busy week for many. It allows the professors, the students, and people from the surrounding community to come together to talk to each other and to hear about exciting studies in many fields.

The lecture series has opened the eyes of many SSU physics majors to the different paths of study and work that are open after earning a degree in physics. The topics vary widely from week to week. Being interested in solid state physics and optics, I was delighted to listen to the lectures in those areas. These included Dr. Robin Cantor from Conductus, Inc., who spoke about SQUID (Superconducting Quantum Interference Device) magnetometry and how these devices are helping doctors view the interior of a body without surgery. Dr. Robert Johnson came from the IBM Almaden Lab in San Jose to tell us about fullerenes, new forms of carbon in large geodesic dome-shaped molecules.

I also enjoyed Mary Howland's lecture on the design of aspheric and progressive lenses. Howland, who graduated in '86, now works for Signet Armorlite, Inc. in San Diego. She was one of four SSU physics graduates who returned to the campus this to talk about what they do in the real world. Dan Nottingham ('89) spoke on his study of the aurora as part of a Boston University research team. The day after the lecture Dan came to the Society of Physics Students meeting for an informal talk over pizza, where he gave his view of graduate school and what to expect.

In the fall Dr. Keyvan Farahani ('85) described applications of magnetic resonance imaging in guidance and monitoring of minimally invasive tumor therapy. Farahani is now on the faculty at UCLA, where he earned his Ph.D. after graduation from SSU. And just this month Lauren Novatne ('89) gave an exciting and well-illustrated account of her work as an environmental health specialist for Monterey County.

There were astronomical lectures by Dr. Dorrit Hoffleit of Yale, Dr. Sallie Baliunas of Harvard, Dr. Roger Malina of the University of California at Berkeley, and Dr. Paul Hodge of the University of Washington. The one I found the most interesting was on laser guide stars and adaptive optics by Dr. Claire Max of the Lawrence Livermore National Laboratory. She discussed how LLNL was using a powerful laser to excite upper atmospheric gases to provide a beacon on which to focus adaptive optics telescopes. The picture of the laser shooting up through the sky against the lights of the city was spectacular.

One of our own graduating seniors, Mallory Roberts, almost deserved a cover charge for the humor in his talk, "X-ray Outbursts from Neutron Stars in Binary Systems," which he claimed could have been titled, "What I Did to Get into Graduate School."

Once again I and many others thoroughly enjoyed the speakers and topics. Dr. Tenn's potpourri of subjects has kept "What Physicists Do" interesting and entertaining. I look forward to next year's lectures and hope to see some old and new friends there.

## OCLI Physicist Teaches Optics

Dave Lamb ('94)

This spring the Sonoma State Physics and Astronomy Department was pleased to have Dr. Bryant Hichwa teach its upper division course in optics. Dr. Hichwa has been the research director at Optical Coating Laboratory, Inc. (OCLI) in Santa Rosa for the past seven years. Having taught both optics and thermal physics courses here in the past, Dr. Hichwa is no stranger to the Sonoma State classroom. He enjoys teaching and says that there is no better way to really learn a subject than to teach it. In his class he likes to emphasize the practical side of things by telling his students what's important and what's not so important in the real world.

The course itself has taken a very practical and applied tone. New to the curriculum was the treatment of geometrical optics problems through matrix methods in which complex systems can be designed and studied using simple arithmetic. Emphasis was also placed upon optical instrumentation (including the human eye) in addition to several rules of thumb and industry standards in optical design. Because of Dr. Hichwa's experience in the industry, students taking his class were able to see how the theory of optics can be put to use as well as the detrimental consequences of ignoring some of the more subtle aspects of the theory. He told us several stories about projects at OCLI that had run into trouble because someone forgot about some small detail buried deep in the theory.

Keeping in tune with the practical approach to the subject, Dr. Hichwa (with the help of Steve Anderson and Rob Lahaderne) presented demonstrations on an almost weekly basis. The demonstrations were particularly useful when discussing the more abstract theory of physical optics. Interference phenomena were vividly displayed using holograms, thin film reflective and anti-reflective coatings, and simple diffraction gratings—making sense out of the simplistic black and white diagrams in the text. The consequences of physical optics literally came to life when it was pointed out that the beautiful coloring of a hummingbird is the result of thin film interference on the bird's feathers, which are actually gray. The end of the semester was topped off with a field trip to OCLI where, once again, the students were able to observe real world applications of the subject they had struggled all semester to learn.

Dr. Hichwa's enthusiasm and experience provided an atmosphere in which a lot of learning took place. Studying a fascinating and growing field under the direction of an expert was truly a wonderful opportunity for everyone enrolled in optics this semester. Dr. Hichwa's presence this spring has been a welcome addition to a diverse and already outstanding physics department, and we are in his debt for helping us out in a time of need.

## Spear to Take Leave

Dr. Gordon Spear will be on sabbatical leave during the Fall 1994 semester. He intends to remain in the area and use the SSU Observatory to continue work begun with Ben Owen ('93) and Matt Davis ('93). The three have been developing the IRAS Catalog of Variable Sources. Dr. Spear will complete some publications, including the catalog itself, and work on enhancing software for analysis of the huge data set. One of the first publications will concern the period-luminosity relation for Cepheid variable stars at the infrared wavelength of 12 micrometers.

The director of the SSU Observatory also intends to investigate the possibility of making use of remote automated telescopes.

## Marckwort to New York for Summer

Physics major Mario Marckwordt has been selected to do research on quantum effects in semiconductor materials at Rensselaer Polytechnic Institute this summer. An enthusiastic physics student, he is excited about the opportunity.

## Alumnotes and Quotes

**FRED ARIOLI ('75)** is a software development engineer with Becton Dickinson in San Jose.

**ARTHUR B. FLYNN II ('76)** is principal scientist for Westinghouse-Hanford Co., implementing and overseeing U.S. Dept. of Energy nuclear safeguards at Los Alamos National Laboratory. He earned an M.A. in security management at Webster University in 1992. He was formerly an F-14 fighter pilot with the U.S. Navy.

**SCOTT C. ANDERSON ('78)** is founder and president of Wild Duck, a computer graphics and educational software company in Rohnert Park, which distributes his popular animation program, *Fantavision*. His book, *Morphing Magic*, which contains software on a disk, has been among the best sellers in the software publishing field.

**DENNIS GOODROW ('78)** is the cofounder and lead developer at Einstein & Goodrow, a software development company in Rohnert Park. He was formerly a scientific programmer for Research and Development Associates, Marina Del Rey.

**RON BLEAU ('79)** is a staff engineer with Lockheed in Marietta, Georgia.



## Astronomy at SSU: The Long and the Short of It

Mallory Roberts ('94)

This year Sonoma State University upheld its tradition of observing the sky all over the electromagnetic spectrum. Radio, infrared, optical, X-ray, and gamma-ray research were conducted by faculty and students. The optical observatory remained active throughout the year, but that is the subject of another article. What makes SSU rare among four-year colleges is the level of active research in what is sometimes called "invisible" astronomy.

On the long end of the spectrum, at the radio wavelength of 21 centimeters, is the experimentation done with the Very Small Array. This two-dish interferometer on the roof of Darwin Hall is the result of eight years of student and faculty work. Since the major hardware components were completed last year, this year's project leader, Mallory Roberts, decided to concentrate on the development of observing techniques and data analysis software. Software suitable for continuous meridian observations has been developed and has been used extensively during the Very Small Array Sky Survey which Mallory is doing as an independent study project. The results of this will be presented at the June meeting of the American Astronomical Society in Minneapolis. He is being aided by biology graduate student Naomi Owen. Meanwhile, Greg Madruga and Daniel Hale have been working on motor control routines and source-finding software. Amanda Tunison has also contributed with data backup help and minor hardware additions.

At a slightly shorter wavelength, Matt Davis ('93) and Professor Gordon Spear have continued their analysis of data from the Infrared Astronomical Satellite (IRAS). The IRAS Catalogue of Variable Stars has been completed, and is now being put into publishable form. This multi-year project, started with Ben Owen ('93), has found thousands of new variable stars in the infrared, and has also allowed a new determination of the period-luminosity relation for Cepheid variable stars.

Getting into the short end of things, Prof. Lynn Cominsky and Mallory Roberts have published their discovery of X-rays from the Be-star/radio pulsar binary PSR1259-63. This system is the first radio pulsar to be found in an eccentric orbit around a massive main sequence companion star. X-rays were discovered near apastron, the point where the pulsar was farthest away from the Be companion. This goes against traditional explanations of X-ray emission mechanisms for this type of system. To explain this, Dr. Cominsky and Dr. Alan King of the University of Leicester have proposed a new model of wind accretion which proposes a much slower stellar wind from the Be-star than is usually assumed. This paper has also been accepted for publication in the *Astrophysical Journal*.

On the extremely short end of things, Dr. Cominsky and Mallory have continued analysis of data from the Compton Gamma Ray Observatory Burst and Transient Source Experiment (BATSE). Their update of the orbital elements of

the X-ray binary 4U0115+63 is currently being prepared for publication. They are also working on a long term light curve of 4U1700-377 in collaboration with the BATSE team at Marshall Space Flight Center in Huntsville Alabama.

Physics students at SSU who are interested in astrophysical research have unusual opportunities. Few other institutions have undergraduates actively involved in such a wide range of astrophysical research. There is much more to do in years to come.

## Optical Astronomy Advances

Amanda Tunison

The SSU Observatory has made several improvements this year which greatly expand our capabilities. The Observatory uses a CCD camera mounted on a computer-controlled 10-inch Newtonian telescope. The images are put on tape and taken across campus to the Imaging Lab, where the data are analyzed.

Private donations enabled the Department to buy a different mount for the Epoch automated telescope. The new mount is much more stable and tracks better than the old one, so it is now possible to take long exposures and still get crisp, clear images. This is a vast improvement over the original mount, which was not able to track reliably for exposures longer than three minutes, limiting the objects which could be studied. Longer exposure times mean we can study fainter objects, including semi-regular variable stars.

The hard drive on the CCD camera control computer was upgraded from a 20-megabyte drive to a 200-megabyte drive. The smaller disk could only store a small number of images, which interfered with long observing runs. The new drive can store hundreds of images, and so can hold several nights of observations. Data are less likely to be lost or corrupted because they stay on the disk while the tape backup is checked for accuracy.

Also new at the Observatory is updated control software for the Epoch automated telescope. The new software lets us create our own database to supplement the standard database already available. Observers can now put a coordinate file on disk before they go out to the observatory, saving time and reducing errors.

The enhanced equipment now available makes new observing programs possible. One of these will examine semi-regular variable stars, which have not been well studied in the past. In many cases even the period is not known, and the variable type classification is questionable. Observations will begin this summer with the goal of establishing light curves for these stars and determining the type of variable involved.

Future plans include making the Observatory remotely accessible by computer, so that observing runs can be conducted without having to make the lonely trek to a cold, faraway building. Currently observers must find an observing partner because it is against policy and common sense to walk alone to the dark, isolated area of campus where the Observatory is located. With a remotely accessible Observatory an observing run could be conducted from the warmth and safety of Darwin Hall, without need of a "bodyguard."

## Alumnotes and Quotes

**RICHARD MONTGOMERY** ('81, physics and mathematics) is an assistant professor of mathematics at the University of California, Santa Cruz. He has conducted research in mathematics at the University of California at Berkeley, the Mathematical Sciences Research Institute at Berkeley, and the Massachusetts Institute of Technology since earning his Ph.D. in mathematics at the University of California at Berkeley in 1986.

*Not only are my memories of the SSU Physics and Astronomy Department still quite dear to me, but it gave me the background and confidence to take on my job here at the NSO. I often say that the MOST important thing one can learn in physics is how to approach a problem. ...I feel that I got this at SSU and for that I am still thankful.*

**CLAUDE PLYMATE** ('81)

Manager, Fourier Transform Spectroscopy Lab  
National Solar Observatory

**MARY C. SILBER** ('81) is an assistant professor of engineering sciences and applied mathematics at Northwestern University. She has conducted research at the University of Minnesota, the Georgia Institute of Technology, and the California Institute of Technology since earning her Ph.D. in physics at the University of California at Berkeley in 1989.

*I owe much of my success, so far, to being able to use both technical and business acumen, in a technical/engineering environment.*

**JAMES EYER** ('83, physics & management)

Research Project Manager  
PG&E

*One of the beneficial aspects of the Physics and Astronomy Department at SSU is to have been able to use equipment and do research programs ourselves, hands-on. ...I loved the technical side. I like nothing better than to have to think up a new system, build it, and then see it run as planned.*

**TERESA BIPPERT-PLYMATE** ('84)

Research Technician  
Steward Observatory

**GEOFFREY A. WILSON** ('84) is doing research in quantum optics at the University of Oregon. A former American Physical Society Industrial Graduate Intern at IBM, he earned his Ph.D. in applied physics at the Oregon Graduate Institute of Science and Technology in 1992.

**BRENTON WHITE** ('84) is a member of the technical staff at Hewlett-Packard Laboratories.

*We just finished a month long deployment, starting out in Brasilia, Brazil for a Chiron occultation, then skipping to Easter Island for a refueling/rest stop (2 nights), and then to New Zealand for our standard annual Kiwi Astronomy. Very tiring, but interesting.*

**BEN BURRESS** ('85)

Observing Assistant  
Kuiper Airborne Observatory

*I feel that my physics education and training at Sonoma State University was instrumental in achieving my career goals. The informal, friendly atmosphere and small class size are just a few of the qualities that made the department so attractive to me. I am proud to be a graduate of the SSU Physics and Astronomy Department.*

**TOM McMAHON** ('85)

Astronomical Instrumentationist  
Yerkes Observatory

**JOHN PALMERLEE** ('85) and his wife run Far View Ranch Camp and are proud parents. He also writes science fiction. He writes that his studies in physics at SSU gave me the tools to answer many burning questions, ...[and] opened the door to true science fiction writing.

**VALERIE LEPPERT** ('87, physics and chemistry) earned a Ph.D. in materials science at Northwestern University in 1994. The holder of a previous B.A. in biology from SSU, she is now living in San Francisco.

**CHRISTOPHER RAY** ('87, physics and applied mathematics) is a graduate student in physics at the University of California, Davis. He has been working summers at Los Alamos National Laboratory, and last fall he taught a math course at SSU.

*My undergraduate education developed my curiosity about physics, physicists and the history of science in general in a way that I am able to read or discuss intelligently about frontier scientific topics even if I am not always familiar with the mathematical reasoning or the experimental details. Being part of this culture is not only useful but very rewarding indeed.*

**PHILIPPE ARGOUARCH** ('88)

Accelerator System Operator  
Stanford Linear Accelerator Center

**GREGORY M. CRAWFORD** ('88) is a regional sales representative for Baker/Norton Pharmaceuticals in the Bay Area. He recently completed a term in the U.S. Marine Corps, where he was an air defense controller at Camp Pendleton with the rank of Captain.



**DOUGLAS EPPERSON ('88)** is a graduate student and teaching assistant in physics at the University of California, Santa Cruz. He received his M.S. in physics at San Francisco State University in 1994.

*My new responsibilities are to help in the design and construction of all-sky imaging systems and to publish occasionally, so I am co-author of two papers regarding Stable Auroral Red (SAR) arcs soon to be submitted to JGR... I seemed to have been well prepared for this position after graduating.*

**DAN NOTTINGHAM ('89)**

Staff Scientist  
Boston University

**LAUREN NOVATNE ('89)** is an environmental health specialist for the County of Monterey.

**MARC AFIFI ('89)**, physics and communication studies) is teaching physics and chemistry at Central High School in Fresno. He coached the Odyssey of the Mind team which placed second at the 1993 state championships. He earned his secondary credential in physical science at SSU in 1990. This summer he will do research at the Stanford Linear Accelerator Center.

*I helped design and build the electronics for the infrared cameras for the Keck Telescope....To do my job, I used programming skills learned at SSU....The digital electronics course at SSU was most helpful....My Physics courses came in very handy in order to understand what the experiment was about in order to make the correct modifications....Basic Physics is used a lot in designing systems that control a large telescope.*

**DAN WILCOX ('89)**

Electronics Technician  
Canada-France-Hawaii Telescope

**ALAN D. GERING ('90)** is vice president for marketing and sales at Micro Machines, Inc. in Fremont.

**BEN HOOD ('90)** is a software manager at Chemical Safety in Richmond.

*Most beneficial from SSU physics education: perseverance in problem solving, the ability to look at a problem in a variety of ways until I find the right approach, being able to change reference points to better solve problem. In some cases the problems I solve at work are technical, in other cases they are management theory. In both cases, my physics education proves beneficial.*

**NANCY KUNNARI ('90)**

Failure Analysis Engineer  
National Semiconductor

*Even though I'm doing atmospheric chemistry modeling now, it seems that it all comes down to physics. The experience I had modeling pulsars at SSU was a great introduction to what I do now except that then I was flying by the seat of my pants...Generally the quality of teaching and instructor understanding of the material was very high. The liberal attitudes of the faculty toward the students were also important. I'm glad to see that the students still have pretty free reign in the department. This adds immensely to the the educational experience.*

**FRANCIS MORAES ('90)**

Graduate Student & Dept. of Energy Global  
Change Fellow  
Oregon Graduate Institute

**DANIEL SWEARINGEN ('90)** is a graduate student and research assistant in astrophysics at Indiana University, where he works on cataclysmic variable stars. He earned his M.S. in physics with a thesis on solar astronomy at California State University, Northridge in 1991.

**DAVID PIAZZA ('91)** is teaching physical sciences at El Molino High School in Forestville. He earned his teaching credential at SSU.

**ERIC WEISS ('91)** is a graduate student and research assistant in physics at the University of Washington, now participating in experiments in particle physics at the Stanford Linear Accelerator Center. He spent the summer of 1991 in the Student Research Participation Program of Argonne National Laboratory, where he worked on a detector at Fermi National Accelerator Lab.

*I like the small size of the Department and the University. It means that a student won't get lost in a large and impersonal department. It also means that there's plenty of opportunity for students to get involved in research projects in a way they never could at a large university.*

**TIMOTHY KIMBALL ('92)**

Archive Specialist  
Space Telescope Science Institute

**PAUL KOHLMANN ('92)** is working on electric cars at U.S. Electric in Sebastopol.

**ALAN DUQUETTE ('93)** provides technical support in the engineering department of Jandy Industries in Novato.

**ELIZABETH HAYS ('93)** is a medical student at the University of California, San Francisco.

## Alumnotes and Quotes

**MONIKA IVANCIC ('93)** is a graduate student in biophysics at Oregon State University. While at SSU she worked two summers at the Stanford Linear Accelerator Center.

**HOLLY JESSOP ('93)** is a graduate student and teaching assistant in astronomy at San Francisco State University.

*Of the courses I had at SSU, I have relied heavily on quantum mechanics, math methods, and the astrophysics you gave us with only 7 students. The examples of real life problems we worked out were invaluable.*

**BEN OWEN ('93)**

Graduate student

National Science Foundation Fellow

California Institute of Technology

**MARK ROBINSON ('93)** is a computer programmer in Cotati. He is writing computerized biofeedback software.

**PAUL SOMERVILLE ('93)** is in product support at TopoMetrix, a manufacturer of scanning probe microscopes in Santa Clara.

*My education at Sonoma State University opened the doors of opportunity for me to apply my previously acquired electronics design knowledge to highly scientific applications. Now instead of working with consumer appliances and cellular phones, I help design and test astrophysical instrumentation that will be used in space. My newly-acquired physics education helps me understand the phenomenon we are attempting to measure, deepening my understanding of the process and increasing the value of my contribution to the project.*

**GREGORY SPREHN ('93)**

Instrument Scientist

Laboratory for Experimental Astrophysics

Lawrence Livermore National Laboratory

Sonoma State University  
Department of Physics and Astronomy  
1801 East Cotati Ave.  
Rohnert Park, CA 94928-3609

Non Profit  
U.S. POSTAGE  
PAID  
Sonoma State  
University