

The **PHYSICS MAJOR**

SONOMA STATE UNIVERSITY

DEPARTMENT OF PHYSICS AND ASTRONOMY

1998

Program Revisions Approved

In December 1997 the Sonoma State University Department of Physics and Astronomy obtained final approval for major revisions of its two Bachelor of Science degree programs.

The most extensive changes were in the B.S. with a Concentration in Applied Physics. The total number of semester units required for the major has been decreased from 75 to 63-64 (46-47 physics, 12 mathematics, 5 chemistry) 9 of which may be used to meet General Education requirements). The changes include the introduction of new courses in opto-electronics and X-ray analysis, a restructuring of the electronics courses, and a reduction in theoretical physics.

The new program is intended to serve the increasing number of students who wish to remain in the area and employers who desire graduates with strong backgrounds in physics, mathematics, and problem-solving abilities. It will also be useful to those who wish to attend graduate school in engineering or applied science.

In addition to completion of the core courses in introductory physics and calculus, electromagnetism, electronics, optics, quantum mechanics, and statistical physics; advanced elective courses; and a senior design project or equivalent; students now choose one or more Areas of Specialization.

Areas currently offered are Applied Optics, Applied Electronics and Devices, and Applied Nuclear Physics. The specialization in Applied Optics includes new courses in lasers, fiber optics, and detectors, while Applied Electronics and Devices includes analog and digital electronics (including microprocessor applications) and the physics of semiconductor devices. Applied Nuclear Physics includes the popular and recently improved courses in applied nuclear chemistry and physics as well as x-ray analysis. All of these courses include both lecture and laboratory components.

The principal change to the B.S. in Physics is the reduction of 4 units of theoretical physics, leaving a total of 71 units (46 physics, 15 mathematics, and 10 chemistry), 9 of which may be used to meet General Education requirements). This remains the recommended curriculum for those intent on graduate school in physics or a closely-related field, such as astronomy.

Both B.S. programs now require a new junior-level course in mathematical physics, which includes the use of powerful symbolic software such as *Mathematica*.

1998



Michael Laufer using the optical time domain reflectometer for testing a fiber optic cable and connectors.

Laser Course Relates Many Fields

Alan J. Witten

Physics 445, SSU's new lasers, fiber optics, and detectors (LFOD) class, is a three-unit lecture course that may be accompanied or followed by either or both of two one-unit lab courses. Professor Saeid Rahimi enthusiastically proclaims, "this is such an important subject, we really needed to expand it."

The course presents theory from an applied viewpoint. It takes key elements from various disciplines of physics and brings them together in an interesting and extremely informative format. Students see how Maxwell's equations from electricity & magnetism, the Schrödinger equation from quantum physics, semiconductor theory, and electronics are all brought together and applied to the field of lasers. LFOD gives the student an understanding of how theories derived from these different disciplines find every day applications.

Following the initial introduction of atomic energy levels, LFOD covers light and its amplification, stimulated emission, and radiation in the form of the LASER beam. Students study Einstein's coefficients along with Boltzmann's distribution. LFOD also brings together and applies topics from the light and optics course.

Once this foundation is built, the various types of lasers are discussed. The characteristic differences and

Continued on back page

Sam Greene Retiring

The most versatile member of the Department of Physics and Astronomy is retiring—but not all at once. Dr. Sam Greene, who has been at SSU since 1966, has taught almost every lecture course in both physics and astronomy, as well as several labs. He directed the laser laboratory and taught the upper division lecture and laboratory courses in lasers and holography from the time Dr. Isaac Bass departed in 1981 until the mid-1990s.

Known for his humor, wide-ranging knowledge, and openness to any type of question, Dr. Greene has also been very popular with general education students taking courses in descriptive astronomy, extraterrestrial intelligence and interstellar travel, and cosmology.

Dr. Greene is retiring under a plan which allows him to continue teaching half-time for five years. In Fall 1997 he began teaching fall semesters only.

Students Have Fun in SPS

Tim Graves

The past year has been an exciting one for the SSU chapter of the Society of Physics Students. The club has gone through some changes during the past few months, and things are really starting to happen.

Just recently the chapter attended Physics Day at Paramount's Great America along with fellow physics students from Stanford and San José State Universities. Club members spent the day educating high school students on the kinematics and Newtonian dynamics involved in some of the rides.

To help promote our primary goal of educating others as well as ourselves, the SPS has also spent a great deal of time advertising the Physics Study Center in Darwin 343 to all students taking physics classes.

Dr. Rahimi graced the SPS with his presence, discussing what our role as "modern physicists" will be in the late 20th and early 21st century. He mentioned possible internships as well as potential job opportunities after graduation.

For an end-of-semester event the club will be visiting the Stanford Linear Accelerator and the *Gravity Probe B* spacecraft at Stanford. Special thanks should go to Dr. Lynn Cominsky who has arranged the whole event. To top it off, she has invited the SPS to a dinner at her home afterward. It has been a wonderful year for the SPS, and we plan for things to keep getting better.

Tim Graves is the president of SPS at Sonoma State.

Applied Nuclear Update

John Dunning

We will offer both of our applied nuclear chemistry and physics courses in Fall 1998. The lecture course will continue the emphasis shift toward biochemistry and health physics along with neutron activation analysis of unknowns. New lecture applications include neutron diffraction and gamma ray astronomy. In the lab course we will exploit our new multi-channel analyzer, EG&G's latest software, and the computer-coupled gamma ray library in *Nuclide Navigator*.

A high-intensity spallation neutron source is in the planning stage at Oak Ridge National Laboratory. Students will be introduced to the nature of this neutron

source, neutron diffraction to study crystal structure, and small angle neutron scattering to study thin films on surfaces.

Gamma ray astronomy now employs detectors whose sensitivity and angular resolution is an order of magnitude better than previously. These detectors are now orbiting the earth. They are revealing much about the center of our galaxy, element formation in exploding stars, and powerful objects at great distances.

In introductory lab courses we have developed new experiments to optimize learning using the gamma ray database in *Nuclide Navigator*. With every gamma known at your fingertips, there are too many possibilities unless you use logical reasons to narrow the search.

New gamma ray hardware includes an 8000+ channel analyzer and a rock-stable amplifier. The software makes energy calibration to within 0.2 keV easy. The result is high precision and the ability to use longer data collection times. An overnight run now yields quality data while the investigator sleeps.

In the advanced laboratory we will again offer neutron activation analysis of your hair using a 0.3-gram sample and Washington State University's reactor, measurement of the uptake of I-131 by the thyroid, and a tour of a local cardiology facility where nuclear techniques are employed.



Leif Noble and Laura Withnell check the X-ray diffraction system before inserting a sample for analysis.

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Edited by Joe Tenn

Written by Chris Addiego, Lynn Cominsky, John Dunning, Tim Graves, Dan Hogan, Saeid Rahimi, Joe Tenn, and Al Witten.

Productive Sabbatical for Dr. Cominsky

Dr. Lynn Cominsky has been on sabbatical leave during this past school year. Her leave was partially funded by a grant from the National Science Foundation's Career Advancement Award program. The program gives funds to under-represented scientists to help them change their career directions.

For the past twenty years, Dr. Cominsky has been doing research in high-energy astrophysics, mostly studying X-ray binary stars. About five years ago she started working with particle physicists at the Stanford Linear Accelerator Center (SLAC) who were interested in building a new type of high-energy gamma-ray telescope. This telescope, called *GLAST* (*Gamma-ray Large Area Space Telescope*) will study active galaxies, pulsars and supernovae in the energy range 10 MeV - 300 GeV. However, it is also the first space observatory with the potential to do particle physics experiments. Exploring the capability of *GLAST* to study several important problems in particle physics was the subject of Dr. Cominsky's NSF proposal. The work has required her to learn some particle physics, which is a significantly different area of research than her previous interests.

One problem, on which she is working with local high school student Daniel Mazeau, involves the ability of *GLAST* to detect high energy line emission from the self-annihilation of supersymmetric particles (WIMPs), whose existence is hypothesized by particle physicists in some Grand Unified Theories. The existence of WIMPs (Weakly Interacting Massive Particles) would also provide a possible solution to the dark matter problem in cosmology. Mazeau's work on this subject with Dr. Cominsky enabled him to become a semi-finalist in the 1997 Westinghouse Science Talent Search.

Dr. Cominsky has also continued her activities as the press officer for the High Energy Astrophysics Division (HEAD) of the American Astronomical Society (AAS). In November 1997 she organized two successful press conferences for the AAS/HEAD meeting which was held in Estes Park, Colorado. Coverage of the two stories was excellent, with front page articles appearing in the Los Angeles Times, and many other dailies, as well as radio coverage and a spot on CNN. The first story reported the discovery of a diffuse halo of high-energy gamma-rays around our Galaxy, while the second provided evidence for "frame-dragging" in binaries containing neutron stars and black holes. Frame-dragging is an effect that is a prediction of Einstein's theory of General Relativity, and refers to the phenomenon where a massive rotating body will drag space-time along with it, as it spins, much like a top stuck in goeey molasses.

Her press activities continued at the January 1998 meeting of the American Astronomical Society in Washington, DC, where she was named one of two new deputy press officers for the AAS. She conducted a press conference on new evidence which indicates that the universe is not only expanding, but that expansion is occurring at an increasing rate. She also organized a press conference on new X-ray and infrared observations of a rapidly spinning black hole in our Galaxy, which shows the first connection between the accretion disk

around the compact object and the formation of jets emanating from its vicinity. It appears that the relativistic jets are somehow turned on by the sudden infall of the swirling disk of material that usually surrounds the black hole. The actual mechanism for forming the jets (which must start outside the black hole's event horizon) remains unclear. The week in Washington was topped off by an appearance on National Public Radio's Science Friday interview show with Ira Flatow, in which she and a scientist from the *Cosmic Background Explorer* mission discussed the astronomical highlights of the meeting.

In addition to Dr. Cominsky's work on the *GLAST* project, she has also been involved in preparing for the launch of the *Unconventional Stellar Aspect* X-ray astronomy experiment, which is on board the *Argos* spacecraft. With luck, *Argos* should finally be launched by the end of 1998. Dr. Cominsky has been leading the effort to ensure that all the calibration data needed to interpret the data are in place and integrated into the software used for scientific analysis. Her collaborators in this project are from the US Naval Research Laboratory in Washington, DC, and from SLAC.

Lockheed Martin Grant Supports Student Research

Professor Saeid Rahimi of SSU's Department of Physics and Astronomy has been awarded a grant by Lockheed Martin to carry out an experimental research project on fiber optic sensors. The \$4,800 award is to be paid to two applied physics students for a project to be completed within the next 18 months. The project is to develop a computer-controlled optical fiber temperature sensor. The user will be able to manipulate the function of the sensor using a virtual instrument programmed on the computer.

Students interested in experiments and research projects on fiber optics and lasers are encouraged to contact Dr. Rahimi (saeid.rahimi@sonoma.edu).

PATRICIA MARRIOTT ('67), SSU's first physics graduate, is now director of corporate marketing at Active Software in Santa Clara.

STEPHEN D. JILKA ('71) is a senior project manager with NCR in San Diego. He earned master's degrees in physics at San Francisco State University in 1972 and in systems management at the University of Southern California in 1979.

BRUCE KEMMELL ('72) teaches physics, mathematics, and astronomy at the University of New Mexico, where he earned his Ph.D. in theoretical physics in 1992.

WILLIAM F. CABRALL ('76) is a lead engineer with the Boeing Company in Colorado. He earned an M.B.A. in finance at the University of Denver in 1985.

The best part of my education at Sonoma State was the small class size coupled with full professors. The opportunities this environment provided were invaluable.

ARTHUR B. FLYNN II ('76) is a physical scientist with the Department of Energy in Albuquerque. He formerly managed the nuclear safeguards and security program at Los Alamos National Laboratory, and before that was an F-14 fighter pilot with the U.S. Navy.

Lab Automation with *LabVIEW*

Chris Addiego

During the Spring 98 semester a significant amount of effort has gone into several projects focusing on automating experiments in the department's photonics laboratory. *LabVIEW* (Laboratory for Virtual Instrumentation and Electronics Workbench), which is a graphical programming language, was the software of choice for this purpose. This software is both powerful and flexible, and it can be used for a wide range of instrumentation projects. Under the direction of Professor Saeid Rahimi, a diode laser experiment, a temperature control system, and a fringe counter experiments were designed and automated. In each experiment the equipment is controlled by a Macintosh computer, and the user can adjust various parameters in a virtual control panel displayed on the monitor.

In the diode laser experiment the current injected into the laser is stepped up, or ramped, to a certain value and power readings are taken from a power/wavelength meter at each step. These L-I curves were taken at different temperatures. From this information the threshold current of the diode laser and the degree of its temperature tunability can be determined. Before automation, students manually ramped the current and manually took a power reading at each point. In order to automate this experiment *LabVIEW* and a data acquisition (DAQ) card were used to modulate the injection current into the diode laser. A voltage is set by the program, therefore setting the injection current, and a power reading is taken by the program at each point. The voltage is increased in steps until the maximum current, which is set by the operator, is reached. The temperature of the laser is changed and another L-I curve is taken. The user determines the number of data points and the maximum current value. The data can be saved to a text file and can be graphed and manipulated for determination of the threshold current.

The next project was a temperature control system. This was designed to monitor a thermocouple and maintain a constant temperature setting. Again, the DAQ card and *LabVIEW* were used to import the data into the computer and also to control a heater. We wanted to have more flexibility than just turning on the heater when the temperature is too low and turning the heater off when the temperature is too high. A system was designed which basically pulses the heater. The pulse duration is determined by how far away the desired temperature is from the actual value. Longer pulse lengths occur when the actual temperature is far away from the desired temperature. If the actual temperature is above the desired temperature then the pulse length is zero. The heater is turned on by setting the voltage output of a terminal of the DAQ card. This voltage is sent to a solid state relay which switches the current sent to the heater. Using this pulsed heater method we were able to achieve very precise monitoring, to within 1°C. More precise temperature detectors will result in even higher precision.

The last automation project was a fringe counter. This was done by using *LabVIEW* to monitor a power meter, taking readings every 10 milliseconds. Upper

and lower power thresholds are entered into the program. The program waits for the power reading to exceed the upper threshold, but does not count a fringe until the lower threshold is surpassed. This program is intended for use in interferometry applications. One limitation of the experiment is an upper limit of the computer to take data. Taking readings every 10 ms is sufficiently fast for most of our applications. The program displays in real time both the power reading and the number of peaks as a function of time.

These automation programs allow the users to focus on the nature of the experiment rather than the details of programming and instrumentation. The programs should be very helpful in the lasers and holography lab and fiber optics and detectors lab, as well as in research projects. Several other projects are good candidates for automation; they may be developed by other applied physics students.

Chris Addiego, assisted by Allan Baker, performed the work described above for his senior design project.



Laura Withnell using a low frequency impedance analyzer with Dr. Saeid Rahimi.

DOUGLAS MORRIS ('78) is a senior manufacturing operations manager with Motorola in Albuquerque. Formerly an engineering manager and engineer, he has been awarded three patents. He is now working on an MBA at the University of New Mexico.

RONALD R. BLEAU ('79, physics and psychology) is a staff engineer in fighter avionics sensors and systems design with Lockheed Martin in Marietta, Georgia.

RICHARD K. DeFREEZ ('80) is principal scientist of Met One, Inc., an Oregon company which develops new products for counting particles in air, gases, and liquids. Honored as one of SSU's Distinguished Alumni in 1995, Rick earned his Ph.D. in applied physics at the Oregon Graduate Institute in 1985.

LANCE ERICKSON ('80) was recently promoted to professor of aeronautical and physical science at Embry-Riddle Aeronautical University in Florida. He earned his Ph.D. in astronomy at the University of Florida in 1987.

The greatest benefit I have derived from my undergraduate education is the mathematical and physics tools that allow me to teach at both the technical and nontechnical levels. My favorite classes were the upper level physics, especially mathematical physics, and Prehistoric to Byzantine Art.

Donations Enhance Program

Private donations are increasingly important to the programs of the Department of Physics and Astronomy at Sonoma State University.

This year several gifts have come from Sonoma County's largest private employer, the Hewlett Packard Company. The electronics and computer firm, which employs at least ten of the Department's graduates, matches its employees' contributions to educational institutions three for one if the contributions are used for HP equipment. The company's equipment finds ready use in the Department's laboratories, and this year several SSU alumni—not all of them physics grads—pooled their contributions to directly enhance the physics instructional program.

Any others employed by HP who would like to have their donations multiplied by four are encouraged to contact the department chair, Dr. Duncan Poland (707/664-2376 or duncan.poland@sonoma.edu) or to call the relevant HP office at 415/857-8481.

Also, through the good offices of Clyde Underwood ('74), a development engineer in HP's Microwave Instruments Division, this year the company donated a Model 8594E Spectrum Analyzer with a Model 85630 test set. These will be used to test and calibrate the detection and amplifier systems of the student-built radio telescope on the roof of Darwin Hall and for examining high frequency modulations in fiber optic systems.

Cash donations are also valuable. They are the sole support of the Department's two public programs, the "What Physicists Do" public lecture series and the Public Viewing Nights at the SSU Observatory; they fund the Horace Newkirk Student Assistantship; and they allow some equipment purchases.

Donors since last year's newsletter are listed below. We are grateful to all.

#63851 PUBLIC PROGRAMS. Bert Brians, Penn-grove; Charles & Judith Buff, Santa Rosa; Theodore Chenoweth, El Verano; Marvin Chester, Occidental; Clover-Stornetta Farms, Petaluma; Albert & Carol Cognata, Santa Rosa; Charles Daymond, Cotati; Donald J. Farmer, Sebastopol; Paul G. Hewitt, San Francisco; James L. Hill ('71), Sonoma; Dale Houston, Petaluma; Paul & M'Lou Ishmael, Rohnert Park; Lucy & Bill Kortum, Petaluma; Francis V. Marshall, Petaluma; Charles & Norma McKinney, Windsor; Bernard Meyers, Novato; Evelyn Norton, Kelseyville; Robert & Bertha Rains, Santa Rosa; Donald & Ann Rathjen, Pleasanton; Marguerite Ross, San Rafael; Timothy & Shirley Sullivan, Santa Rosa; Michael Thuesen, Cotati.

Fund #63852 PHYSICS & ASTRONOMY EQUIPMENT & SUPPLIES. Chuck Bullen ('75), Port Townsend; James Eyer ('83), Oakland; Rebecca A. Freeman ('94); Dennis ('78) & Meredith Goodrow, Santa Rosa; Steven Grossberg ('92), Santa Rosa; David Nielsen ('74), West Jordan, UT; Bill ('96) & Pam Oakes, Sebastopol; Linda Rarey ('88), Santa Rosa; Christopher Ray ('87), Moraga; Else-Marie Schmidt ('94), Healdsburg; David Shoaf ('75), American Fork; Trudy Tuttle Hart ('91), Santa Rosa; Clyde Underwood ('74), Santa Rosa.

#75380 HORACE L. NEWKIRK MEMORIAL STUDENT ASSISTANTSHIP FUND. Nadenia Newkirk, Santa Rosa.

#75960 PHYSICS & ASTRONOMY SCHOLARSHIP (endowment). Lynn Cominsky & Garrett Jernigan, SSU, Duncan & Marion Poland, SSU.

#77020 SCIENCE AT WORK (endowment). Max Machinery Inc., Healdsburg.

#85960 PHYSICS & ASTRONOMY SCHOLARSHIP (current). Joseph Tenn, SSU.

THE CHARLES J. & MARGARET C. DEXTER ENDOWMENT FUND. Charles & Margaret Dexter, Santa Rosa.

Other department funds include

#63853 SSU OBSERVATORY.

#63855 STUDENT DEVELOPMENT PROGRAM.

#78380 JOSEPH S. TENN SCHOLARSHIP (endowment).

Physics and Theatre Mix

Laura Odeh is a physics major and an actress, too. At SSU she has played Ophelia in *Rosencrantz and Guildenstern are Dead*, Constanze Mozart in *Amadeus*, and Hermia in *Midsummer Night's Dream*.

Laura entered SSU as a biology major when her parents moved from San Diego to Santa Rosa, but after taking courses from Professors Sam Greene and Saeid Rahimi she found that, "I enjoy physics. It's like a puzzle."

She will use some of her physics knowledge working in Hewlett Packard's Student Employment and Educational Development (SEED) internship program this summer.

STEPHAN R. CRANDALL ('82) is a manager of software development at Cisco Systems, San Jose, where he develops ATM backbone switches.

WILLIAM C. TOMLINSON ('83) is a technology consultant with Andersen Consulting in San Francisco.

TERESA BIPPERT-PLYMATE ('84, physics and art) is an instrument/observing specialist on the McMath Pierce Telescope at the National Solar Observatory in Tucson.

MICHAEL ROGEN ('84) is sales manager for the western United States for Maxon Precision Motors, Inc., Burlingame.

MICHAEL BROWN BICK ('85) is a graduate student in physics at San José State University.

TOM McMAHON ('85) is at the University of Arizona, where he is the principal systems engineer on the multiband imaging photometer for the forthcoming *Space Infrared Telescope Facility*. He earned an M.S. in instrumentation physics at the University of Utah in 1990.

JOHN PALMERLEE ('85) is an Internet technician at the Doctor's Company in Napa.

LEE STEELE ('85) is a self-employed technical writer in Silicon Valley. He has documented telecommunications and electronics hardware and CAD/CAM software.

What Physicists Do

Alan J. Witten

What do physicists do? Everything! Applying physics to daily life and the world of business is creative and challenging. Just how diverse, interesting, and rewarding a career in physics can be was demonstrated by the two dozen guest speakers who entertained and educated us during the 54th and 55th "What Physicists Do" public lecture series at SSU.

The guest speakers represented various disciplines ranging from business, agricultural consulting, particle physics, plasma physics, and education to astronomy and cosmology. Each topic had its own special charm as speakers gave their spins to their areas of specialization.

We had two lectures on particle physics. Dr. Helen Quinn outlined the priorities and objectives of the new B Factory being built at the Stanford Linear Accelerator Center. Dr. Gregory Kilcup of Ohio State University detailed how his group was using supercomputers with the Lawrence Berkeley National Lab's (LBNL) Visualization Group to simulate quarks interacting in four dimensional space-time.

The industrial sector had a strong representation. Kimberly Wiefing from Hewlett-Packard in Palo Alto, titling her talk, "An Education In Physics: The Technical Path to Career Agility," gave us some insight into the diversity of career opportunities available to those with an education in physics.

Dr. Robert Street of Xerox Palo Alto Research Center discussed the commercial applications of amorphous silicon. We focused on flat panel displays with Dr. Michael Toney of IBM Almaden Research Center and received a better understanding of the development of thin ceramic membranes for fuel cells from Dr. Steven Visco of LBNL.

The research effort going into computer chip technology was apparent following presentations by Dr. Richard Freeman of Lawrence Livermore National Laboratory (LLNL), discussing the use of extreme ultraviolet lithography in the production of current and future generations of computer chips, and by Dr. Xiao-Dong Xiang of LBNL. Dr. Xiang described his group's new process for producing Integrated Material Chips and the impact new materials used in computer chips would have on the commercial markets. And Dr. Michael Riordan presented a fascinating lecture on the invention of the transistor.

Commercial markets were of absolute importance in the area of fiber optic communications as presented by Dr. Dennis Derickson of Hewlett Packard, Santa Rosa.

Lending a different perspective to applications of physics was Michael A. Porter, a Forestville vineyard consultant. He showed the importance of applying physics to agriculture and why some vineyards fail to maximize their grape harvest yields. This was a "nut and bolt," or should I say "leaf and stem", approach to applied physics at the "grape root" level.

Educators were vital to this year's successful program. Dr. Patrick Tam of Humboldt State University gave a quick review of *Mathematica*. Dr. Tam is the author of *A Physicist's Guide to*

Mathematica which is a recommended text at SSU. Dr. Barry Kluger-Bell, who divides his time between the Lawrence Hall of Science and the Exploratorium's Institute for Inquiry, explained the advantages of "inquiry-based science teaching." SSU's own 1993 physics graduate, Matthew Davis, gave us insight into his teaching experiences at Santa Rosa High School.

A wide variety of applications of plasma physics, covering the spectrum from computer chip manufacturing to coatings for plastic bumpers, turbine blades, and potato chip bags, was presented by Dr. Francis Chen of UCLA's Electrical Engineering Department.

Dr. Richard Post from LLNL described the uses of electromechanical batteries, and Dr. Ronald Growsky of University of California at Berkeley presented an exciting talk on using modern electron microscopes to better understand the building blocks of matter.

David Lamb ('94), now a graduate student at the University of Alabama in Huntsville, demonstrated the use of thick optical waveguides for use in illuminating display panels.

Astronomy and cosmology speakers stimulated our imagination. Our own Dr. Lynn Cominsky presented the design and objectives of the *Gamma Ray Large Area Space Telescope (GLAST)* she is working on with an international team. From NASA Ames Research Center, Dr. Scott Sandford reviewed a collection of cosmic dust from comets, described picking up and analyzing meteorites in Antarctica, and discussed spacecraft on their way to comets and asteroids. Dr. Arthur B.C. Walker II of Stanford University presented high resolution images of the solar chromosphere and corona and described both earth- and satellite-based observations of our nearest star. "Dynamic" and "interesting" best describe the presentation of Dr. Mark Adler of the Jet Propulsion Lab, as he discussed past, present, and future robotic missions to the red planet Mars.

From our local frame of reference the universe expands outward in all directions. Dr. Alan Dressler, of the Observatories of the Carnegie Institute of Washington, dazzled us with pictures from the *Hubble Space Telescope (HST)* showing the vastness of our universe. He discussed how the *HST*, and its proposed successor, the *Next Generation Space Telescope*, will help us understand the origins of our planet, our Galaxy, and our universe. Continuing with this theme, Dr. Janna Levin of UC Berkeley discussed the geometry of the universe, and how the designs and shapes in the cosmic microwave background radiation are reminiscent of a leopard's spots or zebra's stripes. The final speaker, Dr. Michael Bolte of University of California at Santa Cruz described the life cycle of stars and how recent observations can be used to determine the ages of the oldest stars, and thus set a lower limit to the age of the universe.

In retrospect, stellar is a good description of this year's lecture series, the success of which was due to the dedication and hard work of Dr. Joseph S. Tenn, who directed both the 54th and 55th semesters of "What Physicists Do." Thank you, Dr. Tenn.

We look forward to next year with great anticipation. Dr. Lynn R. Cominsky will be directing the fall series.



Hogan Wins Newkirk Assistantship

Daniel Hogan was selected this year to be the second holder of the Horace L. Newkirk Student Assistantship. He has been learning about equipment while assisting Steve Anderson with the Department's demonstrations and laboratory setups.

In 1999 Dan will graduate with a BA in Physics and an area of concentration in Art. He attended UC Irvine for a year before transferring to Sonoma State University as a Sophomore. While working his way through college, his jobs have ranged from teacher's assistant to cook at Sonoma State's Children's School, to cashier. He is pursuing a career in astronomy or a related field. He reports that if he had spare time he would enjoy drawing, reading and writing.

The Newkirk Assistantship was endowed by his relatives and friends in memory of the retired physicist who attended "What Physicists Do" for many years.

GEORGE AMORINO ('86) is a research instructor in radiation oncology at Vanderbilt University, where he supervises a radiobiology laboratory. He earned his Ph.D. in cellular and molecular radiobiology at Colorado State University in 1995 and his M.S. in biomedical engineering from CSU, Sacramento in 1988.

STEPHEN MESSINGER ('86) teaches science in Southampton, NY. He earned his teaching credential at SSU in 1987.

As a returning student (at the age of 33), I found the faculty extremely open and encouraging towards me as I prepared myself for a career in education. The intimate atmosphere of SSU furnished me with the environment I needed in order to make a successful job switch.

PETER ROONEY ('86), the American Physical Society's Congressional Fellow for 1997-98, is working in the office of Senator Joe Lieberman of Connecticut. Formerly a program officer working on science policy at the National Research Council in Washington, DC, he earned his Ph.D. in physics in 1995 at UC San Diego.

SCOTT ROWLANDS ('86) is a manager of programs at DSC Communications in Petaluma. He was formerly an engineer at Optical Coating Laboratory, Inc., Santa Rosa.

CHARLES CARPENTER ('88) is a senior member of the technical staff of the Time Space Position Information group at Edwards Air Force Base.

DOUGLAS EPPERSON ('88) is doing research at the HERA accelerator in Germany for his Ph.D. in physics at UC Santa Cruz. He received his M.S. at San Francisco State University in 1994.

LAUREN NOVATNE ('89) is a graduate student in physics at California State University, Fresno.

I feel very fortunate to have received such a good education... What I liked best was the friendly, supportive environment we had to learn in, and the emphasis on astronomy.

KATHERINE RHODE ('89) is a graduate student in astronomy at Yale University. She earned an M.A. in astronomy at Wesleyan University in 1997.

MARC AFIFI ('89, physics & communication studies) teaches physics and chemistry at Pacific Grove High School on the Monterey Peninsula. He is also coach of the Odyssey of the Mind team and a part-time instructor at Monterey Peninsula College. He has worked two summers at the Stanford Linear Accelerator Center. He earned his secondary credential at SSU in 1990.

STEPHEN K. MOSIER ('90) received his M.D. from the State University of New York at Brooklyn in 1998.

DANIEL SWEARINGEN ('90) is a senior software engineer at SoftAd in Mill Valley and the principal of PolyWeb Services in San Rafael. He earned an M.S. in physics at California State University, Northridge in 1991 and an M.S. in astronomy at Indiana University in 1997.

ERIC WEISS ('91) works for Trilogy in Texas. He earned his Ph.D. in physics at the University of Washington in 1998 with research in experimental particle physics at the Stanford Linear Accelerator Center.

ELIZABETH "LIBBY" HAYS ('93) earned her M.D. at the University of California, San Francisco in 1997. She is now a resident at Sutter Medical Center of Santa Rosa.

HOLLY JESSOP ('93) is an astrophysicist at the Smithsonian Astrophysical Observatory, where she works on data analysis software for the Advanced X-ray Astrophysics Facility. She was formerly a research associate at the Center for Extreme Ultraviolet Astrophysics at the University of California at Berkeley.

BEN OWEN ('93) has accepted a postdoctoral research position at the new Albert Einstein Institute for Gravitational Physics in Potsdam, Germany. He just completed his Ph.D. in theoretical physics at the California Institute of Technology, which he entered with a National Scientific Foundation fellowship upon graduation from SSU.

PAUL SOMERVILLE ('93) is a sales engineer for Spectra-Physics Lasers in Mountain View.

DAVID LAMB ('94) is a graduate student and research assistant in physics at the University of Alabama, Huntsville, where he received his M.S. in 1997.

MARIO MARCKWORDT ('95) is working at the Space Sciences Laboratory at the University of California at Berkeley. He earned his M.S. in physics at San Francisco State University in 1997.

CHERIE COPELAND ('95) is a technical support engineer at Advanced Fibre Communications in Petaluma.

My education has allowed me to get a good job as an engineer utilizing knowledge in many different areas in Physics, including optics, electronics, microprocessor applications for testing, as well as my experience in the lab.

DANIEL HALE ('96) has accepted a graduate assistantship in astrophysics at Michigan State University beginning Fall 1998. He is now a grad student and teaching assistant in astronomy at San Francisco State University.

ADOLFO DUARTE ('97) is a network engineer at Hughes Network Systems in Napa.

AMY WEBER ('97) is an engineer at Next Level Communications, Inc. in Rohnert Park.

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applications are explored for gas, solid state, semiconductor, liquid, and free electron lasers.

Other topics covered include the various types of fiber optics, fiber optic components, and fiber optic sensors. Fiber optics is of major importance in communications and related fields. Just how important is demonstrated by the abundance of employment opportunities in these fields within Sonoma County and nearby. The local telecommunications industry has grown substantially over the last few years and continued dynamic growth in this area is expected.

One of the goals of this course is to better prepare SSU graduates for careers in high-tech industries. Employers are currently looking for qualified graduates. To successfully achieve results often requires combining knowledge gained from many disciplines. Applied courses, such as LFOD and its two labs, help to develop critical thinking skills.

In this regard, Dr. Rahimi describes his course as a "highly scientific" one "which integrates the knowledge of mathematics, modern physics (quantum mechanics), electricity & magnetism" and other related subjects. "Applied physics courses are not merely technology and buzz words, there is a goal in mind, and you are looking to achieve that goal using scientific methods and instrumentation."

The course includes a substantial amount of theory which provides the building blocks and background required to understand and interpret the applications of

lasers and fiber optics. The theory is applied in the laboratory where students can see, touch, investigate and experience these applications.

The laser laboratory course, Physics 447, was presented in Spring 1998, while the fiber optics and detectors lab, Physics 449, is scheduled for Fall 1998. With two lab courses now, students can spend more time on each experiment. They can take their time to understand the experiment, its implications, and the real world applications.

In his friendly manner, Dr. Rahimi describes the laser lab environment, as "like a mini research lab...giving students time to explore." This spring the laser lab included experiments using the helium-neon laser, diode lasers, and the more powerful argon ion laser. Alignment of the helium-neon laser was followed by acousto-optic modulation, iodine laser spectroscopy, several experiments with diode lasers, the Fabry-Perot spectrometer, and split beam holography.

I was a student in LFOD the first time it was offered in Spring 1998. I also took the laser lab course. I highly recommend these courses to all upper division physics students, as well as to those already working locally who could use the additional knowledge and skills. Lasers, fiber optics, and detectors, the new applied physics course at SSU, is what employers are looking for.

Al Witten earned a BSEE at CSULA in 1967, worked in the defense industry, and, with his wife, ran his own business for 22 years. He entered SSU this year to pursue a second B.S. in physics.

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