The PHYSICS MAJOR

Sonoma State University · Department of Physics and Astronomy

Cominsky Has Busy Year

The past year has been an exciting and busy one for Professor Lynn Cominsky. Work has continued on her NASA grant to study the X-ray emission from pulsars using HEAO A-1 satellite data. All the scanning data from the entire mission have been brought to SSU and archived on Digital Audio Tape – 15 gigabytes fit on five little tapes! Most of the work was performed by student assistant Greg Sprehn.

Cominsky and Sprehn are now analyzing the data for various X-ray pulsars in the Large Magellanic Cloud. Recently Cominsky was awarded another $58,000 grant from NASA to use data from the Compton Gamma Ray Observatory to study X-ray pulsars at higher energies. The Compton GRO is currently in orbit gathering data, in contrast to HEAO A-1, which ceased operating in 1979. Work on the new grant will start over the summer, and there is funding for a student assistant to make optical observations from the ground to correlate with the gamma ray observations.

In the fall of 1991 Cominsky was one of three SSU faculty nominated for the Excellence in Education Award presented yearly by the Santa Rosa Chamber of Commerce to an outstanding teacher at the college level. She was selected for the award, and received a commemorative plaque during a breakfast meeting held at the Luther Burbank Center.

In January Cominsky and Sprehn attended the American Astronomical Society meeting in Atlanta, Georgia. Their poster paper on the SSU Very Small Array radio interferometer was selected by the AAS as one of three projects to be featured in a national press conference focussing on High Tech Teaching Telescopes.

Most of Cominsky's time during the spring has been taken up with work on the SSU Presidential Selection Advisory Committee. She was one of three faculty representatives elected to serve on this committee, along with a staff

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Miriam Carolin Wins Writing Award

The *Griffith Observer*, a popular astronomy magazine published by the Griffith Observatory in Los Angeles, fills its pages with the winning articles from an annual science writing contest sponsored by Hughes Aircraft Co.

Miriam Carolin ('82) won an honorable mention in the 1991 contest with "Heber Doust Curtis and His Adherence to the Island Universe Theory." She received a cash prize, and her article will appear in the magazine soon.

The article was based on the thesis which earned Carolin a master's degree in history at SSU in 1990. Curtis was an early 20th century astronomer and a leading advocate of the view that the dim, fuzzy objects in the sky called "nebulae" were actually external galaxies, gigantic systems of stars situated far beyond the stars in the Milky Way.

Carolin, who came to the SSU Department of Physics and Astronomy with Comet Kohoutek in 1974, has remained an active participant in Department activities since receiving her B.A. "with honors" and "with distinction." During the first decade of the SSU Observatory (1976-86) she participated slightly more than half of all the times the observatory was used. She continues to work with Dr. Gordon Spear, other alumni such as Chris Espenlaub ('86) and Miriam Tobin ('90), and current students observing active galaxies and variable stars. She also makes weekly sunspot sketches. And last, but not least, she is the much appreciated supervisor of the coffee and cookies before each week's "What Physicists Do" lecture.

Karas Leaving for Colorado

Dr. Richard Karas has been appointed Vice President for Academic Affairs at Western State College of Colorado in Gunnison. Karas taught in the Department of Physics and Astronomy 1974-85, and has continued to teach an occasional course while serving as SSU's Dean of Administrative Services since then.

The Low-Frequency Neighborhood

Ben Owen

Optical astronomy has been around as long as people have had eyes, and x-ray astronomy gets great headlines, but there is a lot to see out in the far infrared as well. The region from twelve to one hundred micrometers covers the chief radiating wavelengths of objects from about 30 kelvins to almost room temperature: comets, asteroids, stellar nurseries, much of the interstellar medium, and other galaxies.

This region is also good for variable star research: eruptive variables spit out infrared-bright clouds of gas and dust, and the "standard candles" of astronomy, such as Cepheid variable stars, are visible to great distances, especially in the populous galactic plane, due to the transparency of galactic dust clouds at these wavelengths. All of our observations of the far infrared come from one satellite, IRAS, which operated for ten months in 1983, so you might think analyzing the data would be a piece of cake.

Wrong. Our own variable star guy, Dr. Gordon Spear, wanted to look at the infrared data on known variables and also on objects which IRAS found to be variable in the far infrared (which might be variable stars previously hidden by optically opaque dust clouds). But he found that the data were scattered in at least four different catalogs, with much duplication, inconsistent standards, and contamination by the cool interstellar material known as "infrared cirrus." So the illustrious Dr. Spear got a grant, hired me to help him sort out this mess, and bought a SPARCstation to help us both.

First he had me make up a partial data file for the known variables which were brightest in the infrared and do some analysis on this preliminary data. I learned how to use the Unix operating system to create data files, then learned Fortran (yuck!) to write programs to analyze the data files. Once we got a look at our data, even in this preliminary form, it was obvious we had a lot of nonstellar objects mixed in with our stars – perhaps dust clouds surrounding young stars like T Tauri, or other interesting objects – so I started writing more programs to simulate stars surrounded by cool dust clouds.

By the end of summer we settled down to the task NASA gave Dr. Spear the grant for – creating the Infrared Catalog of Variable Stars, the Holy Grail that would standardize all our data and put it in the same place. This involved a huge amount of computer work, scraping the data out of the odd niches in which it was stored. Before I got this job I had the strange idea that astronomy involved a lot of sitting at telescopes and looking at pictures, but I found myself sitting in a comfortable room typing at a computer keyboard all day long. Before I knew it I was a Unix mini-guru and had become a system operator on the Department's network of Sun workstations.

So for the last year I've been chasing data around the guts of a computer, but I did eventually get to look at some pretty pictures. Turns out the people down at JPL figured out how to squeeze images out of data that were never meant to be imaged, so we got some gorgeous slides to look at. The pictures helped us correct some of the trickier bits of our data. We found more and more strange anomalies, things that looked like dust clouds and jets (who said all the fun stuff was at the short wavelengths?) and finally – we thought – got our catalog put together. Then just a few weeks ago the illustrious Dr. Spear took a trip down to Pasadena to visit the home of the data and found out they had made a small error in their data processing; namely, they had about 9000 more previously unknown variable objects for us. Compare this with the 30,000 or so variable stars the optical astronomers have discovered since ancient times, and you get an idea of the situation. Sure looks like we've got our work cut out for us this summer!

P.S. Next month, at the American Astronomical Society meeting in Columbus, Dr. Spear and I will present "The IRAS Catalogue of Variable Sources: A Preliminary Description."

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Katz Scores on Math Exam

Physics major Alon Katz was the second highest scorer at Sonoma State University on the 1991 William L. Putnam Exam. This annual mathematics contest draws more than 2000 entrants from among the top math students in the United States and Canada. Katz's score, in the top 30% nationally, was good enough for a cash prize provided by faculty and friends of the mathematics department to the top local scorers. Katz hopes to do even better next year, his last year before graduation.

Notes on a Fine Sabbatical

John Dunning

During my sabbatical leave last fall I was fortunate to visit Los Alamos National Laboratory in New Mexico and the University of California at Davis and generally to reinvigorate myself. I worked at the Los Alamos Neutron Scattering Center (LANSCE), the premier neutron scattering facility in North America. I assisted Los Alamos scientists in obtaining data from small angle neutron scattering and from neutron diffraction on stressed metals. My knowledge of neutron optics was significantly enhanced. The new material was included in Physics 340 light and optics this spring.

I visited the reactor there and arranged for Los Alamos to expose samples for use in our applied nuclear courses, Physics 481 and 482. We will ship samples of students' hair. Los Alamos will irradiate them with neutrons in their reactor and return the now-radioactive hair to Sonoma State via next day air. Students will use our gamma ray detector to measure the residual radioactivity, and thus determine the trace element concentrations in their hair.

I made it a point to visit the Nuclear Waste Isolation Pilot Project (WIPP) near Carlsbad Caverns. The WIPP site is scheduled for storage of low level waste left over from various military programs. Testing with real waste is about to begin. I attended a seminar on the "Past, Present and Future Status of WIPP."

At UC Davis I visited with the proton-induced x-ray fluorescence group. Here elements are made to fluoresce by proton bombardment using the Crocker Nuclear Laboratory cyclotron. This exciting technique is very useful to detect trace elements on thin samples. For example, air can be sucked through filter paper. The particulate matter deposited on the surface of the filter paper can easily be analyzed for trace elements.

Some of the time at Davis was spent exploring the possibilities of a scanning electron microscope (SEM).

The SEM is a very powerful tool for investigating surfaces with magnifications up to 300,000 (compared to a light microscope's useful limit of approximately 500 power), and the SEM's depth of field is much greater. Images can be stored as digital data. This allows quantitative comparison from sample to sample or between different portions of the same sample.

An x-ray detector can be mounted on the SEM, and x-ray fluorescence can be used to make an element-by-element map across the sample simultaneously with the visual image. The fluorescence is induced by electron bombardment. The electron-induced fluorescence can detect 1% relative concentrations on surfaces, and it is in use throughout industry.

With the SEM, biologists can study surfaces of intact organisms, and geologists can study mineral surfaces. Physicists can study the fluorescence process itself. I hope these applications will be powerful attractions to students.

At $240,000 a SEM with x-ray capability is expensive. If we can get half the funds from an NSF grant, it can be within our reach. We need to be optimistic about obtaining the other half.

Another Good Year for SPS

Holly Jessop

Under the direction of President Holly Jessop, VP John Newton, and Secretary-Treasurer Geoff Syphers, the SSU chapter of the Society of Physics Students began the year with a camping trip in the Lassen National Forest and a tour of the nearby Hat Creek Radio Observatory. There was plenty of entertainment at the campsite: John experimented with the physics of bonfires in small camp stoves, Lynn sported the most fashionable camping equipment and the most awesome tent, and Holly's dad spent many hours constructing the most intriguing tent out of a single piece of scrap tarp material. The next day we were all pleased to discover that we seemed to know a great deal more about radio telescopes than our graduate student guide. We all got to practice explaining to one another what we've learned from our own Very Small Array about the operation and theory of a radio interferometer.

Under the direction of Greg Sprehn, VSA meetings continued to be the most highly attended and popular SPS events – except for the meeting that featured "Chicken Boy Lives!", which a majority of the department's physics majors and faculty actually attended.

Monika Ivancic spoke to SPS about her research at SLAC last summer, and Jason Alexander discussed and demonstrated the jet engine that he constructed (with support from his employer, Max Machinery) as a senior design project. Mike Fink gave a talk on his summer research at UC Davis, and Holly Jessop spoke about recent observations with the SSU CCD camera. And once again Dr. Tenn held an informative seminar on grad school.

Other activities of SPS included a tour of the Stanford Linear Accelerator Center, participation in Science Night, and an evening of lectures, demos, and observing with the Melville Montessori School. Also, John Newton has worked steadily on the new SPS/VSA T-shirts, and order forms should be available this Fall.

Congratulations to next year's SPS officers: President Ben Owen, VP Greg Sprehn, and Secretary-Treasurer Mallory Roberts.

Very Small Array Makes Progress

Greg Sprehn

This year the VSA went digital. Last summer I installed an analog-to-digital converter in the receiver, so we don't have to deal with the inky chart recorder any more. Using parts gleaned from the Physics 412 microprocessor applications course and some scrounged cable, I was able to send the data directly into a port of the Sun workstation we affectionately call Charmian (after Jack London's wife). Observations are now stored on disk, and transferred to tape when the disk gets full. (We collect over two megabytes an hour). We have observed radio galaxies Cygnus A and 3C 400, as well as the day and night sky background levels.

When we read in an International Astronomical Union (IAU) circular last month that Nova Cygni was in outburst, we decided to give it a look. Unfortunately, interference from the sun prevented us from confirming that the nova was active at 21 centimeters. A later IAU circular from the VLA (the Very Large Array in New Mexico) pegged the radiation at that wavelength as well below our sensitivity.

While trying to make that observation, however, we discovered that the new analog-to-digital converter was limiting our sensitivity, so I modified it. The receiver now has a "high-sensitivity" switch, which increases the sensitivity at the sacrifice of the ability to handle bright signals. Now we observe weak sources in the "high" position, and go back to the "normal" position for strong sources like the sun and Cassiopeia A. Analysis of the data is accomplished with Fortran programs written by John Newton as his project in the Physics 381 computer applications for scientists class. We normalize the data, Fourier transform it, and look at the power plot to see if the predicted fringe rate of the observed source appears. Observation of 3C 400 required the analysis, since in the raw data the fringe period was obscured by noise. Mallory Roberts is writing a simulator for the VSA, so we can characterize the performance of the system using known input and then compare to observational results.

We received $2000 from the national Society of Physics Students this spring to motorize the dishes. We have been doing manual pointing with crude protractors and a bit of guess work. Soon we will be able to point accurately and dynamically follow a source, which means we will increase our effective sensitivity. Bill Stockton of Compumotor Corp. arranged for the donation of two more stepper motors, bringing our total to four. We have purchased the drive gears and chain from a Honda 250 Scrambler (yes, a motorcycle) and a 30:1 gear reducer (surplus) to drive the azimuth. Scott Noack is writing motor driver code in his Physics 412 class, so the Sun workstation can take over the pointing operations. Knowing where to point requires some celestial computation, so I am writing the tracking software that will compute the altitude and azimuth of the observed source every few seconds and send new coordinates to Scott's driver software. The whole software system is being developed in modules, which allows several of us to write code, and then we will put the whole VSA control and analysis into one package.

In January we presented a poster paper at the Atlanta meeting of the American Astronomical Society (AAS), and it is on display in the Darwin lobby now. I described the VSA in two short talks, at the Association of North Bay Scientists at Solano Community College, and in the annual California State University Research Competition. No, I didn't win, but I had a great time, and I have been asked by the Stockton Astronomical Society to give a one-hour talk in July. I guess I am going on the lecture circuit with our very own VSA story.

Recently Dr. Cominsky and I submitted a proposal to the American Astronomical Society. We asked for $3000 to perform tracking observations with the VSA and to present the results at next summer's AAS meeting.

Meetings continue on Tuesdays at noon, during the semester, in Darwin 329. Stop by to get more information, or send me an e-mail message: sprehn@charmian.sonoma.edu.

Rahimi to H-P for Fall

After ten years at Sonoma State, Dr. Saeid Rahimi is going on sabbatical leave. He intends to spend the Fall semester in the wave technology section of the Microwave Technology Division of Hewlett-Packard Co. in Santa Rosa. He says, "I shall be doing research on optoelectronic devices such as solid state lasers (and possibly fiber optics). I hope to use epitaxial growth techniques to make the devices to be studied. The purposes of the study are to become familiar with the process, to work on some new ideas, and to try to help solve some existing problems."

In 1991 Rahimi and SSU technician Vern Shuck published "A Microcomputer-Controlled Linear Heater" in the *Review of Scientific Instruments*, describing instrumentation they invented while developing the Department's semiconductor physics lab. The student simply enters the temperature, and the computer-controlled heater brings the sample to that temperature and holds it. Rahimi expects to bring back more new ideas for the lab after a semester in industry.

Good Year for "What Physicists Do"

Mark Robinson

This has been a very good year for the Department's public lecture series "What Physicists Do." Drs. Lynn Cominsky and Joe Tenn did a fine job of finding speakers with exciting, sometimes controversial, topics. Science teachers, often with students in tow, and individuals from as far away as San Francisco and Kelseyville made the weekly trek to Darwin Hall.

Dr. Eric Norman of the Lawrence Berkeley Laboratory kicked off this year's series with a discussion of the possible discovery of neutrinos with a 17.2 keV rest energy.

Dr. Mary James of Reed College explained optical effects on matter in an understandable way using a wave model of light. With her clear explanations and her gentle sense of humor, it is easy to see how she made it to the *Rolling Stone* honor roll of top professors.

Bruce Erickson, one of three Hewlett-Packard engineers who built the receiver for the SSU Very Small Array radio telescope, discussed its theory and design. UC Berkeley astronomy professor Carl Heiles described his award-winning 21-cm radio observations of hydrogen in the Milky Way.

Dr. Anne Mayes of the IBM Almaden Research Center described her use of neutron scattering to study polymers.

Prof. Sam Greene of Sonoma State discussed the use of computer software in the lasers and holography lab. Dr. Greene has automated many experiments with new software which displays virtual instruments, easily changed via software, on the computer screen.

One of the most entertaining lectures ever heard in the series was given last fall. Dr. Cliff Stoll, author of *The Cuckoo's Egg*, told the story of how he caught a computer spy. Everyone already knew the story, but that was compensated for by the considerable exuberance displayed by Dr. Stoll. When he saw that the lecture was going to exceed the allotted time he pulled the clock off the wall and disconnected it from one supply wire and left it dangling by the other one. A running gag for the rest of the lecture was to grab the clock and, after reading the stopped clock, declare that there was still plenty of time. When students started to come in for the class that followed the lecture he dismissed them, declaring, "Class has been cancelled, you can go home."

Another author, Dr. Leonard Shlain, discussed his recently-published *Art and Physics*. His thesis is that changes in paradigms in the art world preceded or coincided with the same perceptual changes in science.

Two of the most exciting lectures in the spring were about very small devices made from semiconductors. Dr. Richard S. Muller and Dr. Daniel Chemla, both UC Berkeley professors, described their research. Muller is working on the integration of micromechanical devices with microelectronics, Chemla on quantum well optoelectronics.

A bubbly model of the universe was presented by Dr. Andrei Linde, from Moscow by way of Stanford University.

Dr. Don Correll from Lawrence Livermore National Laboratory discussed the current state of fusion research. He predicted that commercial delivery of electricity from fusion is fifty years away.

Dr. Anthony Fainberg of the U.S. Office of Technology Assessment said that he didn't think fusion energy would ever happen because it is always fifty years away, and it will be too expensive to build the plants. He also blasted the Strategic Defense Initiative ("Star Wars") as impractical.

Dr. Jay Davis also talked about nuclear weapons. A nuclear expert at Livermore, he was sent by the United Nations to inspect Iraqi nuclear facilities after the Gulf War. He had some very exciting stories to tell about chasing around after a disassembled magnetic separation plant that the Iraqis were trucking around the desert.

Both Dr. Peter Ryge from Science Applications International Corp. and Dr. Fainberg discussed methods for detecting explosives in airline baggage. Fainberg gave an overview of the field, while Ryge discussed his company's development of instruments using neutron activation of nitrogen.

Also talking about neutrons was the Department's nuclear physicist, Dr. John Dunning, who told us about his work on sabbatical leave at Los Alamos last year.

Allyson Bishop, a graduate of the Department, came from UCLA, where she is about to complete her Ph.D. in medical biophysics. She is working on the production of microliter quantities of radioisotopes that are used as sources in positron emission tomography.

Dr. Sandra Faber of Lick Observatory talked about some of the optical problems and scientific achievements of the Hubble Space Telescope. After computer deconvolution, HST pictures are sharp enough to be useful.

Dr. David Koo, also from Lick Observatory, discussed his observations of distant galaxies, evidence that the universe has a long-range periodic structure. He suggested that the universe may be a series of bubbles.

It is a good thing that "What Physicists Do" is popular with the community, as private donations are now its sole means of support.

Summer Research at SLAC

Monica Ivancic

A summer research internship is a great opportunity for every physics major. One gets to familiarize oneself with certain physics fields, and one can discover how many different fields there are in physics. Research projects are available in everything from astronomy to high energy physics, and most often a student will find himself or herself programming a computer.

Last summer Holly Jessop and I participated in the Summer Science Program at the Stanford Linear Accelerator Center. This was a neat program, because there were 17 other students there from all over the U.S. We all lived in six mobile homes and, in a sense, formed our own community on the Stanford campus. Except for Holly and me and a couple of other students, we had never met before and had a lot of new friends to make.

The bus would pick us up at the trailers every morning at 8 a.m. and take us up to SLAC, where we would hear a lecture on accelerators, detectors, particle physics, ground motion, or a similar topic. Each day there would be a different topic. Afterward we each went to our work place, usually a shared office or a trailer. At SLAC each of us was assigned to a different advisor, so we all worked on different projects.

My project was to research the final focus system of the Next Generation Collider, a linear accelerator that is being designed by an international group of physicists. I wrote a computer program that would ideally place quadrupole magnets in the beta exchange section so as to make the path of the particle most efficient and to make the beam of particles most concentrated at the interaction point. I was fortunate that my advisor was easy to get along with and spent a lot of time helping me on my project.

On the other hand, Holly was assigned to an advisor whom she saw only twice during the whole summer. However, she did get an opportunity to work with graduate students on the beam line used for synchrotron radiation. The experiment she worked on was on photoemission spectroscopy. Other students worked with synchrotron radiation or detector groups, yet most students were using a computer.

In the afternoons we mainly worked on our projects. Every Friday there was a scheduled tour; we visited the Lawrence Berkeley Laboratory, Hewlett-Packard, IBM-Almaden, and Lick Observatory on Mt. Hamilton, which we visited in the evening so as to observe distant stars and galaxies. A few times we had barbecues in the evenings or on weekends. We organized a few weekend group trips to Big Sur, Armstrong Woods, San Francisco and the Santa Cruz boardwalk.

Holly and I were fortunate to get accepted to this program. Most of our activities were well organized, and we were all part of the group. SLAC has one of the oldest summer science programs in the U.S. I think a summer research experience is an excellent opportunity for physics majors, and we should all participate in one before graduate school.

Environmental Science at Davis

Michael Fink

Last summer I had the opportunity to work with the Air Quality group of the University of California, Davis and with the staff of the Crocker Nuclear Lab. It gave me a chance to hang out with, and learn from top scientists, as well as the mechanics, electricians, and office staff who work with them. Also I got to be inside and up close to a cyclotron nuclear lab.

My project, under Prof. Tom Cahill, was to test, in a very careful and quantitative way, a solar power system for a pump to be used in a remote air sampling unit. I worked with a high school student and a graduate student.

Our data are significant because tests of this kind were never done so carefully before. Our final conclusions are a bit surprising in that the system appears to be more efficient than was previously believed. In the past, similar samplers were run with two $400 solar panels. We found evidence that the system can run reliably with one solar panel, cutting the cost of the system by about one-third.

I was given a chance to be a scientist. Cahill told us what he wanted us to find out, and left it to us to figure out a way to do it. I helped to design the set-up and think up experiments to obtain the data needed. This involved a lot of learning, relearning, and applying of electronics. I also got a feel for what a large project entails – days and days of regular, careful data readings.

Finally I put what I had learned into a report so that it can be useful to somebody else some day. We will publish our findings in *Atmospheric Environment* at a later date. Still further tests will be run by the graduate student. I hope my report will assist him in writing the final paper.

This experience has influenced me. I will either take what I have learned with me to graduate school, or share it with the high school students I will be teaching. I enjoyed research, and now that I know how to do it I'm sure to have side projects going long after I am out of school.

Summer Research Ahead

Ten Sonoma State University physics majors will be doing research this summer – and getting paid for it. Six students have won places in national competitions, three will be working with faculty at SSU, and one has been hired directly based on his experience here.

The University of California, Irvine, physics department will see three SSU students among the eight in its National Science Foundation-sponsored Research Experiences for Undergraduates (REU) program. **Nicko Melville** and **Paul Somerville** will work in experimental plasma physics with the Irvine Torus. **Alon Katz** will investigate materials with ultra-high-speed lasers.

Scott Fraser and **Sean Fraser** will be in the REU program at the College of William and Mary in Williamsburg, Virginia. The twins have not yet received their assignment but hope to work in oceanography.

Monica Ivancic will spend this summer in the REU program in the physics department of the University of Notre Dame in Indiana, and **Greg Sprehn** will develop instrumentation at Lawrence Livermore National Lab.

Holly Jessop has won a California State University system predoctoral award which will support her astronomical research at SSU with Drs. Lynn Cominsky and Gordon Spear. **Ben Owen** will continue development of a catalog of infrared variable stars with Spear. And Cominsky intends to hire one more student.

All of the students named above intend to graduate in 1993 and then pursue advanced degrees. All will have a head start in research.

More Astronomy at SSU

Holly Jessop

During this past year at SSU, I continued to pursue my interests in variable stars. I finally finished up a research paper on two variable stars that I had begun during my summer at the Maria Mitchell Observatory in 1990. I presented this paper to the Association for North Bay Science (ANBS) and to the American Association of Variable Star Observers (AAVSO). I returned to Maria Mitchell for a few days and completed a project and paper involving another RR Lyrae variable. This paper was presented this past January at the American Astronomical Society meeting in Atlanta. Both papers have been submitted for publication in the *Journal of the AAVSO*.

Last summer the SSU Observatory's new autoguider made it possible for me to acquire a few hours of photometric data with the CCD camera on the variable star AM Hercules. This star is an important member of a class of cataclysmic variables consisting of a pair of stars, a white dwarf and a red dwarf companion, between which mass is transferred. Once each orbit (usually about three hours), the bright accretion system is blocked by the red dwarf, creating a minimum in the light curve. The light curves that I obtained during the summer indicated that AM Her was in a low-state of accretion. Results were sent to the International Astronomical Union in 1991.

In November I observed the star BY Cam at the University of Arizona 40-inch telescope on Mt. Lemmon. This star is the most erratic member of the class of polars, and is of particular interest since it displays extreme variations in accretion geometry. The photometric data we acquired during this observing run with the SSU CCD camera are expected to confirm that BY Cam is indeed undergoing synchronization. If this is true then BY Cam will provide the first observable system for testing how inflowing material couples to a magnetic field. In Arizona we obtained light curves spanning seven hours (nearly two orbits) over seven consecutive nights. I am now engaged in the formidable task of reducing 300 megabytes of CCD images. First results were presented at this year's ANBS meeting at Solano College. To support this research I have received a California State University predoctoral grant, and a Sigma Xi Research Society grant.

This summer I will be working further on the BY Cam data and preparing a paper. I will also be continuing photometric observations of AM Her, and possibly other cataclysmic variables and white dwarf stars, with the SSU CCD camera, and I may travel to observe with telescopes at other observatories. I will also be working on satellite data for Dr. Cominsky.

Tenn to be Away in Spring

Dr. Joe Tenn has been awarded a sabbatical leave for the spring semester of 1993. He plans to visit several archives and old libraries, both in the United States and in Europe, to gather information for a series of articles he is writing for *Mercury*, the magazine of the Astronomical Society of the Pacific (ASP).

The articles are scientific biographies of the astronomers who have been awarded the ASP's highest honor, the Catherine W. Bruce medal, for a lifetime of contributions to astronomy. The first appeared in the Jan/Feb 1990 issue, and at the rate of six articles – and one new medalist – per year, Tenn expects to catch up and write about the current medalist in the year 2006. He presented a paper on a topic in the history of astronomy at a 1991 American Astronomical Society meeting in Seattle and was an invited speaker at a meeting of Pacific Northwest physics faculty in Idaho in April.

Department Producing Teachers

After a long drought, the SSU Department of Physics and Astronomy has begun to produce teachers again.

Three graduates went into teaching in the early years of the Department. First was **Jim Hill** ('71), who finished his college education after a lengthy stint in the air force. After SSU, he taught physics and electronics for seventeen years at Los Gatos High. In 1989 he returned to his home town of Sonoma and took a position at Piner High School in Santa Rosa. There he has joined with biology and chemistry teachers to obtain a grant to set up an integrated science program with emphasis on computer applications and working with local industry. Next year he and an electronics teacher will set up an applied physics course centered on projects in the community. According to Hill, "There are many good things happening in high school education. The teachers of the future will be required to be generalists, comfortable in teaching in areas out of their major. This way the teacher gets to share the excitement of learning with the students."

Roberto Ramirez ('72) earned his credential at UCLA, and then came back to Healdsburg High, where he currently chairs the mathematics department. A popular teacher, he was nominated for Sonoma County Teacher of the Year in 1991. He also teaches part-time in the SSU Mexican-American Studies program.

John Proud ('73), has taught at private prep schools in Hawaii ever since receiving his credential from SSU. Last year Proud attended a few "What Physicists Do" lectures while spending a sabbatical leave at the Exploratorium in San Francisco.

During the next eleven years only one of the Department's graduates went into high school teaching. The new era began with **David Lapp** ('84), who got his credential at SSU and then taught for four years in a Chicago suburb, concurrently earning his master's degree in physics at De Paul University. He led a group of high school physics students from throughout the U.S. on a People to People tour of the Soviet Union, then accepted a position teaching physics and calculus at Tamalpais High in Mill Valley. This year he has also taught part-time in the Department, and he recently published an article in *The Physics Teacher* on the dissection of a cow's eye as an optics demonstration. "I found that I really love teaching," he says. "It gives me an avenue to be creative, passionate, and autonomous, and it allows me to do something I have always wanted from a career: to leave some sort of meaningful legacy."

Recent years have seen more and more graduates teaching. **Walter Carter** ('87) is teaching mathematics at Paramount High in southern California. He writes, "It's pretty interesting to watch the kids. I do value what I'm learning about people, about myself, and about math – I'm even learning still about the physics."

Victoria Moore Hewitt ('87) enjoys teaching science at Slater Jr. High School in Santa Rosa. "My Sonoma State physics professors inspired me to be a teacher," she says.

Marc Afifi ('89) is now teaching at Dublin High School in the East Bay. In his first year, Afifi reports "Teaching is the hardest job I've ever had, and it's also the most enjoyable."

Physics graduates **Christian Wagner** ('89), **Jim Garrett** ('90), and **David Piazza** ('91) are currently enrolled in the SSU credential program in physical sciences, and **Steven Grossberg** of the class of '92 has just been admitted for the fall. Garrett is "student teaching" physical science at Santa Rosa High and Cook Jr. High this spring. He finds it "quite enjoyable. It's really a chance to learn about science in a different way. As the instructor you get to look at it from another side. I learn new things every day." A former SSU football player, he is also helping to coach the current team.

SSU Experience Practical

Anthony R. Blume

I had been employed by Hewlett-Packard as an electronic technician for about six months when I found myself having difficulty learning the additional theory that I needed to advance in my career. I realized that the problem was due primarily to a lack of mathematics and physics background. I enrolled at SSU with the intention of taking just enough mathematics and applied physics courses to assist my studies in electrical engineering. After a couple of semesters, I found myself very interested, and I continued to take courses on a part-time basis. In June I will receive a B.S. in physics with a concentration in applied physics.

The mathematics and physics courses that I took were instrumental in allowing me to advance through the technician ranks and eventually to obtain the position of associate engineer in a research and development lab. My specialty is microwave computer simulation, and the primary focus of my research at this point is towards developing very accurate high-frequency computer models of microstrip components and structures used in surface mount technologies. After graduation I will continue my employment with Hewlett-Packard. In the fall I will begin work towards a Stanford M.S.E.E. degree through H-P's Honors Cooperation Program.

Contributions Make a Difference

As state budget cutbacks become increasingly severe, private contributions are making it possible to maintain at least some of the high quality of physics education at Sonoma State University. So that donors can specify exactly where they would like their money to go, the Department of Physics and Astronomy has several accounts, both direct and endowed, with the SSU Academic Foundation. All contributions made to either type of account are under the direct control of the Department.

Donors can help support scholarships for physics majors by contributing to either the annual or the endowed **Physics and Astronomy Department Scholarship Fund** or to the **Joseph S. Tenn Scholarship Fund**, an endowed fund. Awards are made through the university scholarship program. (In 1991-92 physics majors Clinton Bruce, Scott Fraser, Sean Fraser, Libby Hays, Monica Ivancic, Ben Owen, Greg Sprehn, and Peggy Trimble received academic scholarships from these and other funds).

The **Science at Work Fund** was established by John Max of Max Machinery Co. in Healdsburg, to support the "What Physicists Do" public lecture series. Income from this endowed fund helps the department to bring in prominent scientists from outside the area.

The Department also has three direct fund accounts: The **Radio Telescope** account is used to purchase equipment for the student-built interferometer system on the roof of Darwin Hall. New research projects and improvements to the radio telescope will be aided by future donations.

The **Public Programs** account provides direct funds to help support the "What Physicists Do" lecture series and Public Viewing Nights at the SSU Observatory and this newsletter.

The **Physics & Astronomy Supplies** account supports the purchase of new materials for use in the laboratories (another victim of state budget cuts). Contributions from Fred Aves and others have been used this year to purchase a major upgrade to the neutron source in the nuclear laboratory.

The recent donation by EG&G Reticon of a linear diode array and supporting electronics enabled Tina Rosenberg to build a linear spectrophotometer in the lasers and holography laboratory for her senior design project. Dr. Lynn Cominsky, advisor to Rosenberg's project, said "I hope the private sector will continue to support public education during these times of statewide financial cutbacks."

Tax-deductible contributions made out to SSU Academic Foundation may be sent with a note indicating the donor's choice of accounts, if any, to Dr. Duncan Poland, Chair, Department of Physics & Astronomy, Sonoma State University, Rohnert Park, CA 94928.

Thank You!

The Department of Physics and Astronomy wishes to express its gratitude to the following 1991-92 donors to the funds described above:

SCIENCE AT WORK (PUBLIC PROGRAMS ENDOWMENT): Mr. John Max, Max Machinery, Inc., Healdsburg.

PHYSICS & ASTRONOMY PUBLIC PROGRAMS: American Physical Society, New York; Mr. & Mrs. Robert Abbey, Rohnert Park; Mr. & Mrs. Ben R. Burmester, Petaluma; Mr. & Mrs. Gene Carrington, Vallejo; Mrs. Ruth Clary, Petaluma; Mr. & Mrs. Charles Dexter, Santa Rosa; Mr. & Mrs. Will Gipple, Novato; Dr. Francis Halpern, Santa Rosa; Dr. & Mrs. William Kortum, Petaluma; Dr. & Mrs. Robert G. Kuehnert, Vacaville; Mr. & Mrs. Carl Marschall, Penngrove; Mr. John Max, Max Machinery Inc., Healdsburg; Mr. Bernard H. Meyers, Novato; Mr. Horace L. Newkirk, Santa Rosa; Mr. & Mrs. Robert K. Rains, Santa Rosa; Dr. & Mrs. Robert S. Tuttle, Santa Rosa.

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JOSEPH S. TENN SCHOLARSHIP: Mrs. Edith Tenn, Van Nuys; Mr. & Mrs. Daniel Tenn, Calabasas; Mr. & Mrs. William Kolitz, Woodland Hills; Prudential Foundation, Newark, NJ.

Alumnotes

ARTHUR B. FLYNN II ('76) is assistant general manager for training operations of the U.S. Dept. of Energy nuclear safeguards and security central training academy in Albuquerque. He earned an M.A. in security management at Webster University in 1992.

LANCE ERICKSON ('80) is associate professor of seronautical and physical science at Embry-Riddle Aeronautical University, Daytona Beach, Florida. This summer he is simulating dwarf galaxies on a supercomputer at NASA Ames Research Center. He earned a Ph.D. in astronomy at the University of Florida in 1987.

MARY C. SILBER ('81) is a research fellow in the applied mechanics department at the California Institute of Technology. She received her Ph.D. in physics from the University of California at Berkeley in 1989.

BRETT MORGAN ('82) is system operator on CompuServe for Symantec Corp., San Jose.

DAVID MUNTON ('82) is teaching mathematics at Austin Community College and the University of Texas, Austin, where he earned his Ph.D. in physics in 1991.

Cominsky

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member, two students, three community representatives, and three CSU trustees. Over 175 résumés were screened by the committee, which narrowed the applicants down to five candidates who visited the campus. Afterward, the committee sent two names to the CSU Trustees, who will select the new SSU President at their meeting on May 20.

Also during May, Cominsky will give a public lecture at the Morrison Planetarium in Golden Gate Park entitled "X-ray Visions of the Universe: Black Holes, Pulsars and Quasars."

In June she will attend the launch of the Extreme Ultraviolet Explorer satellite, on which she worked for five years before coming to SSU.

Alumnotes

GEOFFREY A. WILSON ('84) is doing postdoctoral research in quantum optics at the University of Oregon. He earned his Ph.D. in applied physics in 1992 at the Oregon Graduate Institute of Science and Technology.

MICHAEL ROGEN ('84) is a sales engineer with Maxon Precision Motors, Inc., Burlingame.

NORMAN E. BASHAM ('85) is a quality assurance analyst with Symantec Corp. in Santa Monica. He writes software utilities for the Norton Group.

TOM McMAHON ('85) is now at the Yerkes Observatory of the University of Chicago, where he is developing instrumentation for NASA's Kuiper Airborne Observatory (on which he formerly flew) and for an observatory at the South Pole. He earned an M.S. in scientific instrumentation at the University of Utah in 1990.

DAVID FASSETT ('87, physics and computer science) is a senior programmer with Radix Systems in Cambridge, Massachusetts.

VALERIE LEPPERT ('87, physics and chemistry) is a graduate student and research assistant in materials science at Northwestern University. She is working on superconductors.

CHARLES CARPENTER ('88) is a specialist with Computer Science Corp. at Edwards Air Force Base.

NANCY KUNNARI ('90) is a failure analysis engineer with Microchip Technology in Chandler, Arizona.

SUSAN KNAUS OSBORN ('90) heads the quality assurance department at Meridian Data, Scotts Valley.

ROBERT ST. CLAIR ('91) is a marketing engineer for Hewlett-Packard Co., Rohnert Park.

TRUDY TUTTLE HART ('91) is an engineer with Optical Coating Laboratory, Inc., Santa Rosa.

HUGH SHACKLETT ('92) is a supervising mechanical engineering technician in the ocean engineering design division at Mare Island Naval Shipyard.