THE PHYSICS MAJOR

Department Celebrates 100 Grads with Reunion

Last June the SSU department of physics and astronomy awarded its one-hundredth bachelor's degree. To celebrate this event, the department held a reunion banquet on May 31.

A total of fifty persons attended, including twenty-two graduates, all of the department's faculty, and spouses and guests. After an excellent dinner, presented on campus, Dr. Duncan Poland provided some humorous reminiscenses of his fifteen years in the department.

The department's first graduate was Patricia Marriott who received her degree in 1967. She later earned an M.S. in computer science at U.C. Berkeley and is now employed as a software development engineer with Hewlett-Packard in Santa Clara. She was unable to attend the reunion, but the fourth graduate, William Parr, was there. A longtime employee of Sonoma County, Bill works as a senior systems analyst in the county's data center. He and his wife came from Forestville for the event.

The graduate who traveled the farthest to attend the reunion was David Sheaf, who, with his wife, came from Salt Lake City, where David works as a programmer/analyst for Ireco Chemicals.

It was easy to tell who was who. In conjunction with the banquet, the department published a brochure, "The First One Hundred Graduates." Written by Dr. Joe Tenn, the brochure listed 103 graduates and anticipated (June 1980) graduates, with information about 89 of them. Only 14 failed to reply to Tenn's persistent questionnaires.

The grads are an impressive group. The great majority make considerable use of their physics backgrounds in their professions. A substantial number have earned advanced degrees. And one was busy trying to recruit the June grads in order to earn bonuses from his Silicon Valley employer. (He succeeded, but to date has not shared the bounty with the department.)

Optical Levitation

by Jacques P. Schlumberger

"A very short experience in attempting to measure these light forces is sufficient to make one realize their extreme minuteness--a minuteness which appears to put them beyond consideration in terrestrial affairs."

-John H. Poynting
Address to the British Physical Society, 1905

Recent experiments by Arthur Ashkin at the Bell Telephone Laboratories and by two students at Sonoma State University have demonstrated the great significance of light forces. Sonoma State students Rick DeFreez and Keith Soreng used a dye laser pumped by an argon ion laser to levitate silicon oil droplets about 40 microns in diameter and to hold them in suspension for as long as 45 minutes. They also did work in surface wave resonance. Radiation pressure due to light energy has undeniably gained "consideration in terrestrial affairs."

Soreng and DeFreez had been inspired by the work of Ashkin, whom DeFreez (who graduated from Sonoma in 1980) visited at the Bell Labs in New Jersey during the summer of 1980.

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Dunning Returns from Stanford Sabbatical

John Dunning, recently returned from six months at Stanford University, reports on his sabbatical leave activities.

I. X-RAY FLUORESCENCE USED TO DETECT IODINE TAGGED TO LEUKEMIA CELLS

I became aware of the Stanford Synchrotron Radiation Laboratory (SSRL), when the deputy director, Dr. Herman Winick gave a seminar here at Sonoma in our "What Physicists Do" Series. He led me to Dr. Theodore Zipf, then at the Children's Hospital at Stanford. Leukemia, a major cause of early childhood death, was a focus of Dr. Zipf's research. He believes that more headway could be made if an easy way of tagging small numbers of leukemia cells could be found. One needs to reliably trace these cells through their life cycles.

The project we undertook was to detect the presence of the iodine tag by using the radiation from SSRL to excite the iodine to fluoresce. We would measure the fluorescence in the X-ray region where it is particularly free from the fluorescence of other elements in the system. The experiment undertaken was to determine the actual sensitivity limits with existing equipment at SSRL and to explore possible improvements.

Discussions began in January, 1980. I submitted a proposal on July 11, 1980, and was granted 40 hours of running time at the end of July. During this period I designed and ran an experiment which detected 10^{14} iodine atoms (2×10^{-8} grams). These are better by a factor of 20 than had been previously achieved. The results lack a factor of 10,000 from the sensitivity thought to be required.

Calculations were carried out on improved designs. It is possible these will be implemented in the future.

In any event, I thoroughly enjoyed participating in an experiment from start to finish.

II. ON THE TRAIL OF AN X-RAY MICROSCOPE

During the course of the iodine experiment I met Professor Alan Litke, an old colleague, now at Stanford. I agreed to help him with an X-ray microscope that he and two undergraduates were trying to construct. A good portion of the remaining months at Stanford were spent on this. *Dr. Dunning described this work in the "What Physicists Do" Series March 9.*

Briefly, X-rays have advantages which may be used to differentiate the parts of small structures. First, their wavelength is very short. The resolution limits improve with shorter wavelength. Second, and perhaps more significant, the X-rays can be used to cause specific elements in the sample to fluoresce. If we can map out the locations of this fluorescence, we have a map of the distribution of that element in the sample. For example, phosphorus, iron, manganese and calcium are important but minor constituents of many cells. If we knew their distribution in the cell, this would be one more clue to their role in the cell's processes.

An electron microscope can in principle be used to do this. However, the sample must be in vacuum, and it needs to be very thin. The vacuum restriction is severe as most biological samples contain a great deal of water. In the vacuum the water is removed and the structure changed.

Early attempts at an X-ray microscope were undertaken by Horwitz and Howell at Harvard (Science 178, 608 (1972)). The source of exciting X-rays was decommissioned for lack of funds and the idea lay dormant until revived by Professor Litke and given new life by the intense source of X-rays at SSRL.

The problems with an X-ray microscope revolve around intensity and focusing. The intensity of high energy X-rays at SSRL is the highest in the world. So, the odds are best there. Focusing is accomplished largely by using a pin hole, much as a pin hole camera focuses by eliminating unwanted light. The size of the hole defines the limit of resolution. Initial runs were made with a hole 10 microns in diameter during July. When I joined the project, I was given the task of calculating everything and of making a smaller pin hole.

By the end of December I had successfully developed molds which should result in a two micron diameter hole. We would really like a one micron hole (or better). The resolution limits on a light microscope is roughly 0.5 microns. Work continues.

I also evolved a series of calculated intensities and sensitivities to selected elements using the beams and X-ray optics available at SSRL. These theoretical predictions are the basis for the system being constructed.

Although incomplete, it is exciting work on the frontier of human endeavor. I plan to return to Stanford next summer to participate.

III. OTHER ACTIVITIES

Professor Dunning also had the opportunity to participate in several seminars and group meetings which he hopes will bring a fresh, current outlook to his courses at Sonoma State. He further hopes that his investigation into an automated x-ray fluorescence system will lead to additional resources for faculty and students in anthropology, chemistry, geology, and physics and astronomy.

I will close this by reemphasizing that I am grateful for having had the opportunity to spend six months away in this manner. The course of my life has been altered for the better. I will try to impart some of this to our students.

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Student Profile: Denise Paquette

If you see a striking young woman with long blond hair carrying a motorcycle helmet through the halls of Darwin, you probably see freshman physics major Denise Paquette.

Denise came to Sonoma State with strong mathematical and mechanical skills. She got a head start in calculus at Novato's San Marin High School last year. And her hobby is motorcycles. "I am always working on engines," she smilingly admits.

When the weather prohibits riding her motorcycle from Novato to campus, Denise rides the bus. She claims to do most of her homework on the Golden Gate Transit. She has to be efficient because she works five evenings a week as a janitor in San Francisco. She also does some work for the family janitorial firm in Novato, sometimes early in the morning before coming to classes.

Denise enjoyed introductory astronomy last semester. Her interest in astronomy and space is one of the reasons she chose to major in physics. She has other interests as well, including lasers and materials.

This semester she is taking first semester physics with lab, second semester calculus, and general education courses in U.S. History and Political Science. And maintaining her Honda.

Lynn Hubbard Receives Doctorate

In September 1980 Lynn Hubbard became the fourth SSU physics graduate to earn a Ph.D. She was awarded the doctorate in physical chemistry by the University of California, Riverside for a two-part dissertation. The theoretical part was on the photo-physical properties of the visual chromophor. This is the molecule in the eye that absorbs light. Lynn also performed experiments on acid aldehydes. She used laser induced fluorescent spectroscopy to investigate these molecules.

Now a postdoctoral researcher at the University of California, Berkeley, Lynn is doing theoretical work with Dr. William Miller on molecular dynamics.

Upon receipt of her B.S. (with distinction) in physics from Sonoma State in 1975, Lynn was awarded a prestigious national fellowship in atmospheric science. The fellowship allowed her to attend any graduate school in the country and also provided for summer research at the National Center for Atmospheric Research in Boulder, Colorado.

According to Dr. Hubbard, "The foundation in physics obtained (at Sonoma State) has been invaluable to my graduate research in physical chemistry. The encouragement and enthusiasm of the faculty members provided an excellent environment for learning."

The first graduate of the department to complete a doctorate was Paul Goodwin, B.S., 1971, who earned his Ph.D. in geophysics at the University of Alaska in 1977. Paul is now President of Earth Science Consulting and Technology Corporation in Anchorage.

Next was Bob Steele, B.A., physics and mathematics, 1970, who was awarded a Ph.D. in physics by the University of California, Santa Barbara, in 1977. Bob is a postdoctoral researcher at the Laboratory for Atmospheric and Space Physics of the University of Colorado.

The department's second graduate, Ken Larson, B.A., physics and mathematics, 1969, is now associate professor of mathematics and computer science at Southern Oregon State College. His doctorate, in information and computer science, was awarded by the University of California, Irvine, also in 1977.

Faculty Changes

Dr. George L. Johnston resigned from the Sonoma State University faculty at the end of the 1979-80 academic year. He had taught at SSU since 1969, except for three years when he was on leave at the Massachusetts Institute of Technology and the California Energy Commission. He returned to Boston where he is again conducting research in plasma theory in the MIT physics department. We miss him.

At the same time, the department's senior faculty member, Dr. Duncan E. Poland returned to full-time teaching. Dr. Poland was never really away, but had served the campus in administrative positions for six years. During all of that period, as Chairman of the Division of Natural Sciences and as Dean of Faculty, he continued to teach at least one physics course each semester. Now the department welcomes him back. He adds strength to the electronics and solid state programs, and to several laboratory courses, as well as to the standard physics courses such as Physics 214 and 314, both of which he is currently teaching.

Dr. Isaac L. Bass is away for a second year. Last year he did laser research in the department of applied physics at Stanford University; this year he is working with lasers at Quanta-Ray, Inc. He will describe this work in his "What Physicists Do" lecture April 6.

Student Profile: Richard Cydzik

The starting center fullback on the SSU Soccer Team is a physics major who speaks three languages without an accent.

Richard Cydzik chose to major in physics because he has always been interested in how things work. He likes rockets and engines and expects to become a mechanical engineer someday, perhaps in his native Brazil. In the U.S. Navy, he spent five years on board a repair ship, the USS Ajax. He and his shipmates repaired other ships in the fleet. Last summer Richard worked on a nuclear power station in Mississippi as an assistant field engineer.

Now he is busy studying. He did so well in logic that he was asked to help teach the course the following semester. He enjoyed calculus and astronomy last semester and is currently taking his first physics course. And he always finds time for a few units of independent study in Russian, a language he speaks as fluently as English or Portuguese.

Observatory Five Years Old

The Sonoma State University Observatory is five years old. It was dedicated by Dr. Robert P. Kraft, President of the American Astronomical Society, on 22 April 1976.

Since that date the Observatory has been used for hundreds of nights of student projects and research, class outings, laboratory classes and the ever-popular Public Viewing Nights. It has also been used in the daytime for the past two years by Miriam Carolin, who makes weekly sketches of sunspots as seen through the 14-inch telescope.

With eleven lecture courses and three laboratory courses, Sonoma State has one of the nation's most extensive undergraduate astronomy programs. Under the guidance of Observatory Director Gordon Spear, students conduct a significant amount of research.

On March 30 Stephanie Snedden will speak in the "What Physicists Do" Series on work which she has done with Dr. Spear and Jim Mills. They observed the Be star 28 Cygni at the Mount Laguna Observatory of San Diego State University. This work will be published soon.

Currently, the main research program of the Observatory is the monitoring of a group of Seyfert galaxies, often called the "missing links" between ordinary galaxies and quasars. These objects flare up irregularly. Each week students photograph the Seyferts, then measure the brightnesses of the photographic images with the microdensitometer in the basement of Darwin Hall. Students currently working on the program are Mark Ballard, Berle Beliz, Miriam Carolin, Tom McMahon, and Jim Pisano. John Dotta and Steve Hinch are former members of the team.

Students have also measured the magnitudes of several variable stars and tracked asteroids. The current SSU catalog contains astronomical photographs taken by students Laurel Allen, Paul Avellar, Teresa Bippert, Miriam Carolin, Steve Clark, R. J. Leckey, Barrie Stebbings, and Norm Whyte. All but two of the pictures were taken at the SSU Observatory. Barrie Stebbins also had her photograph of the Andromeda Galaxy on the cover of the fall schedule of classes.

The stature of the astronomy program is seen each spring when the Bulletin of the American Astronomical Society publishes observatory reports from observatories throughout the U.S. and Canada. SSU is one of only a handful (usually four) undergraduate institutions to present reports. The others are from purely research institutions, such as the Kitt Peak National Observatory or NASA, or from graduate universities where the research is done by post-doctoral fellows and graduate students. The first five reports submitted by Sonoma State list a total of 21 astronomical publications by the students and faculty.

To commemorate the fifth anniversary of the Observatory's founding, there will be a display on the first floor of the Salazar Library from April 20 to June 5. Don't miss it!

(If you haven't yet made it out to the Observatory, note that public viewing nights are scheduled for April 10, May 9, and May 29.)

Peter Lucke Joins Faculty

by Jacques P. Schlumberger

Dr. Peter Lucke specializes in dust -- not the kind you shake out of your doormat or the kind that parches your throat on hot days. Lucke's specialty is the interstellar variety spread throughout our galaxy and beyond.

A native of Glendale, California, Lucke (pronounced "Lew-key") joins the department for the 1980-81 academic year. Having earned his BA in physics at Occidental College in 1965, Lucke continued his studies at the University of Washington in Seattle where he received his MS in astronomy in 1967 and his Ph.D. in 1972. Lucke's doctoral thesis, called "OB Stellar Associations in the Large Megellanic Cloud", was written under Dr. Paul Hodge. Research for the thesis included two trips to Chile for observations.

The years 1974 to 79 found Lucke doing post-doctoral research at Geneva Observatory in Switzerland. There he continued his specialized studies in the distribution of interstellar dust which included a 2 1/2 month stay in Chile.

This is Lucke's first teaching experience. He says he find it a pleasant if demanding change from research. When he can find some spare time, Peter Lucke enjoys amateur radio operation, water-color painting and black and white 35mm photography.

He is currently teaching descriptive physics -- a course in which he enjoys presenting many demonstrations -- and three astronomy courses. His extensive background in observational astronomy is of much use in presenting upper division astrophysics, the introductory astronomy laboratory, and descriptive astronomy.

Student Profile: Keith Brister

If you go to the Learning Assistance Center in the library for help in Physics 114 or 214, chances are your tutor will be Keith Brister. Always cheerful and soft-spoken, Keith is the conductor of weekly "workshops" for Physics 114.

One of a trio of outstanding junior physics majors (with Mark Zimmerman and David Munton), Keith won a scholarship for academic achievement last year. Now he is looking toward solid state physics as a career.

Physics is not his first major, though. Keith started out as a music major at Cabrillo College in Aptos. Later, at Foothill College in Los Altos, he studied music, electronics, and mathematics. He plays guitar and steel pedal guitar, mostly jazz. At Foothill, he wrote a computer program to find all the chords available on the latter instrument as a function of pedal positions.

He finds little time for music now. This spring he is taking electricity and magnetism, theory of light, mathematical physics, quantum laboratory, programming for scientists, and critical thinking.

Keith likes the small classes and accessibility of the professors at SSU. He also likes tutoring. "It's the best way I can think of to review previous classes," he says.

Computers in Undergraduate Physics

by Jacques P. Schlumberger

Computers, computer driven plotters, and microprocessors, all found in SSU science courses, are part of the technology of modern physics. Imagine the following scenario:

With the flip of a switch, a metal cylinder of about five pounds embarks on a short journey from the ceiling to a small sand pit on the floor below. As the cylinder's velocity increases, the student is presented with an instantaneous readout of speed on the television screen before him. The cylinder strikes the sand with a muffled thud and the student types some coded instructions onto a typewriter-like keyboard. The screen responds with three columns of figures. The first column represents a set of data points where readings of speed were taken; the second the cylinder's velocity at that point; and the third the cylinder's acceleration due to gravity. Some more typed instructions and the screen goes blank. When it lights up again, the student sees a linear graph with time depicted on the horizontal axis and velocity on the vertical axis. A diagonal dashed line ascending from left to right across the screen represents the theoretical velocity of the cylinder as it dives from ceiling to pit. Almost, but not quite, overlaid on the dashed line is a solid line representing the best graphical fit to the student's experimental data points.

If the experimental and theoretical points are close together, the student pushes another button and walks over to the plotter to obtain a hard copy of the presentation on the screen. If the experimental and theoretical lines are far apart, several more runs might be made, with the student keying in instructions that each new run should be plotted on the same set of axes in a different color. Total time for the experiment and graphical output is less than five minutes.

The experiment just described examines Newton's Laws of Motion. It is among the first experiments performed in the first undergraduate physics lab.

Here is a scenario of the same experiment as it might have been performed two years ago: The cylinder is released and falls toward the floor along a wire track. An electric sparking device attached to the cylinder burns small spots at timed intervals onto a strip of paper stretched parallel to the track. After the cylinder hits the pit, the student counts the spots on the strip of paper and measures the distance from one spot to the next. From these time and distance measurements, velocity can be calculated. A plot of velocity versus time is made from these calculations. The data points don't fall in a straight line, so a least squares calculation with standard deviation is made to determine the best straight line fit. If the least squares line is far from the data points, the whole tedious process might be repeated again. The time elapsed between dropping the cyclinder and producing the graph may be several hours.

Today the introductory physics lab at Sonoma State University follows a middle path between these two scenarios. Speed may still be determined by counting the spots on a strip of paper, but the graphical analysis is usually made easier with a Tektronix 4051 Graphics System. This system makes a linear plot from the data and instantly performs a least squares fit and standard deviation calculation. Work which formerly took hours is now accomplished in minutes.

The day of the undergraduate experiment run completely by computer is not far off, however. Dr. Gordon G. Spear, Associate Professor of Physics and Astronomy, foresees at least one microcomputer system with graphics capability in every lab within the next five years. Thus the student would be able to perform instantaneous graphical analysis in the lab. Time could then be spent understanding what the experiment means, explains Spear, rather than plotting points on graphs. Spear goes on to predict the coming of a computer system the size of a small pocket calculator which might plug into a larger system for more expanded functions. "The small computer," he says, "will become as common in the physics lab as the oscilloscope and the volt meter."

Computing facilities now available to physics students at Sonoma State include the campus PDP 11/45 and the statewide CDC CYBER 174 timesharing systems, as well as the Tek-- all with graphics capability. (Before the fall semester begins, the statewide CYBER system will be replaced by an even more powerful on-campus CYBER.)

Almost every lab course for physics and astronomy majors now requires some computer use. Besides the introductory lab courses, Spear requires the use of the computer in his introductory astrophysics and observational astronomy courses to compute stellar models. Professor John Dunning has written his own software for use in neutron activation analysis.

Professor Joe Tenn requires his students to use the computer for at least one assignment in each of his upper division lecture courses. Last semester his students computed rocket flights in analytical mechanics. This spring he will spend three weeks in the mathematical physics course teaching numerical analysis.

A new computer science curriculum is currently in the planning stages at SSU. When it begins in a year or two the Physics and Astronomy Department will provide courses in analog and digital electronics. In addition, Dr. Richard Karas is developing a new course, to begin Fall 1981, in microprocessors; and Spear hopes to offer a three-unit course in computer graphics as well.

As Spear points out, it would be a disservice not to introduce the student to the computer and its applications. The computer is already the single most important tool for the presentation and manipulation of data. No science curriculum is complete without extensive training in its use, and the parameters of that use expand daily.

H-P Project

by David Munton

Within the last 50 years the world has undergone a revolution in electronic devices. The large vacuum tubes, inductors and capacitors have in many cases given way to modern solid state devices. These devices are considerably more compact, and usually require less maintenance than the older devices. The modern solid state devices are interesting, not only because of their wide range of applications, but also because a good deal of physics is involved in understanding how they function.

One of the primary desires of the manufacturers of these devices is to increase their efficiency, often by decreasing the number of impurities and defects in the device material. Impurities can often be controlled or their effects negated by introducing other impurities. Defects are much harder to deal with. Because many devices are "grown" by letting evaporated material condense on a substrate, defects will not appear until the devices are complete. These defects can be characterized as being areas of disorganization in an otherwise ordered crystal lattice.

Currently Chris Lose and I are engaged in examining the defects present in an epitaxially grown layer of Germanium on a Gallium Arsenide substrate, in the hopes of answering two questions. The first is, can the degree of crystallinity of the Ge layer (its freedom from defects) be measured in some way? Currently, we are examining suggestions that X-ray or electron diffraction may be used to answer this question. The second question we are examining is, can a Germanium crystal lattice, which has been deliberately destroyed through proton bombardment, ever be restored to approximately its original form? This is of importance because one method of producing certain solid state devices involves masking useful areas with gold and then bombarding the device with protons. The protons destroy the lattice, effectively isolating the different areas on the device. If some series of conditions can occur to restore the lattice to an approximation of its original form, the different areas of the device will no longer be isolated, and it will fail.

While the second of our questions is perhaps the more important, since it concerns device failure, it now appears that a technique for examining the crystallinity of the Ge layer will be necessary to find the answer to the question of lattice restoration.

Student Profile: Kitty Chelton

In June Kitty Chelton will graduate with a double major: physics and biology. After that she plans to take a year off to decide whether to go to graduate school in medical physics or to medical school.

Kitty came to Sonoma State from Atlanta to study biology. She had friends in Santa Rosa and liked the area. Her course of study changed when she took general physics from Dr. Richard Karas.

After that, she says, "I majored in Rich Karas." She followed him from general physics to electronics, then to digital electronics and environmental physics. The next move was obvious. She became a double major. The flexibility of the B.A. program allowed her to tailor her curriculum to her interests: much chemistry and biology, not so much calculus-based physics.

Still she is taking a heavy load of physics courses in her last semester: the quantum laboratory, popular optics, scientific programming, and her favorite, applied nuclear physics and chemistry.

She is also planning an independent studies project in x-ray fluorescence to be done jointly with Keith Brister and Maria Reed under the supervision of Dr. Duncan Poland. Already adept at the use of many instruments, Kitty joined with Maria Reed to demonstrate the mass spectrometer at the last Science Night.

Kitty likes the physics and astronomy department. "I get a lot of positive reinforcement from the enthusiastic teachers," she notes. She particularly enjoys Dr. John Dunning's enthusiasm in the nuclear laboratory. This has led her to seriously consider medical physics as a career. Her favorite biology courses were embryology and electron microscopy.

She still finds time to run three to five miles each day. Where will she run next?

Scientists to Gather at SSU

On Saturday, May 9, the newly formed Association of North Bay Scientists will hold its first annual meeting. Scientists from a dozen institutions, from College of Marin to Humboldt State University, will gather in Darwin Hall to present, and hear, papers on research in the sciences.

Student papers are particularly encouraged. One of the reasons for the formation of the ANBS, according to Dr. Joe Tenn, is to provide an opportunity for students to present their research results and to learn what other students are doing. Dr. Tenn is a member of the committee planning the event.

Professor Melvin Calvin of the University of California, Berkeley, will present the keynote lecture, "Energy Plantations." Calvin, who won the 1961 Nobel Prize in Chemistry for his work on photosynthesis, is currently trying to grow plants which produce an oil-like sap on his Healdsburg ranch. The winner of every prize awarded by the American Chemical Society, and a past president of that society and of the American Society of Plant Physiologists, Calvin is also conducting research on synthetic chloroplasts. He will speak on this effort to split water as plants do in his "What Physicists Do" lecture May 11.

Students interested in presenting their research results, either in a ten minute talk or in a poster session, should contact Dr. Tenn before April 10.

Physics Grads Working Locally

Time was when SSU physics grads had to go south -- to Silicon Valley or Los Angeles -- to find physics-related employment. But times have changed. There is an increasing number of technologically oriented firms in the local area, and more and more graduates are finding careers without moving. As the area grows this trend is likely to accelerate. Already Hewlett-Packard has announced plans to build a facility which will eventually employ ten thousand persons just across the street from the campus.

Here are some local employers and the SSU physics grads they employ:

SONOMA COUNTY

Aesop Institute, Sebastopol: David Jacuzzi, B.A. '81.

Heller Laboratories, Santa Rosa: Richard Bromagem B.A., '75.

Hewlett-Packard Company, Santa Rosa: Ross Goodwin, B.S., physics and mathematics, '78' Clyde Underwood, B.A., '74.

Lasergraphix, Santa Rosa: Sharon West, B.A., '77.

National Controls, Inc., Santa Rosa: William Kramer, B.A., physics and English, '77.

Optical Coating Laboratory, Inc., Santa Rosa: Edward Knudsen, B.A., '73; Michael McBride, B.A., physics and management, '75; Basil Swaby, B.A., '74.

Sonoma County: William Parr, B.A., '69.

Sonoma State University: Kent Nelsen, B.A., '74.

Space Microwave Laboratories, Santa Rosa: Joseph Fraser, B.S., '75.

True Time Instrument Company, Santa Rosa: Chad Gillease, B.A., '80.

MARIN COUNTY

Fairchild Semiconductors, San Rafael: Albert Naudin, B.S., '79.

Fireman's Fund Insurance Co., San Rafael: Lisa Foreman Bacon, B.A., physics and French, '74; Eileen Philips, B.S., '74.

Optical Sciences Group, San Rafael: John C. Nelson, B.S., '76.

Suntek Research, Corte Madera: Alexander Bentley, B.S., '76.

Several graduates have started their own businesses in the local area. Robert P. Lucas, B.A., physics and chemistry, '76, is the cofounder and president of Solar Energy Engineering in Santa Rosa. Robert E. Porter, B.S., '71, and Donald Greenberg, B.A., '77, are associated in Synthos Labs, Sebastopol. Scott C. Anderson, B.S., '78, is president of Sonoma Softworks, Camp Meeker; and James A. McBride, B.A., '75, is president of McBride and Associates Business Computer Systems, Petaluma.

SPS Chapter Increasingly Active

The Sonoma State University chapter of the Society of Physics Students was dormant in 1979. Last semester, we reorganized. We now have 13 official members. Fred Blau and Laurel Allen are President and Vice President, respectively.

One of the activities last semester was a talk by Professor Joe Tenn on career opportunities in Northern California. The Club also supplied coffee for all physics students during finals week.

This semester we plan field trips to such places as Lawrence Livermore Laboratory, NASA Ames, and U. C. Berkeley. We plan to have speakers, including SSU physics graduates who have gone on to graduate school or are doing research. We also hope to have some film presentations.

In addition to the extra-curricular activities listed above, we will hold a spring party. It will be an opportunity for everyone to get to know one another.

Student Profile: Tom McMahon

Last June Tom McMahon graduated from Sonoma Valley High School. Today he is conducting research in astronomy.

How did Tom get such a fast start? During each of his last three semesters in high school Tom participated in the SSU early entrant program. He took Descriptive Astronomy, Introductory Astronomy Laboratory, and Discovering the Galaxies.

When he entered the university as a regular student in the fall Tom already knew his way around the observatory. He began joining Miriam Carolin in photographing Seyfert galaxies as part of an ongoing research program directed by Dr. Gordon Spear. Tom often observes with Mark Ballard, a transfer student from College of Marin who also entered in the fall with some astronomical background. The newcomers regularly join Miriam in using the microdensitometer to measure their photographs.

Tom has been interested in astronomy since he saw the "Project Universe" television series a few years ago. He has done a lot of reading on the subject and has his own 3-inch refractor. He is a member of the Sonoma County Astronomical Society, the local amateur club which includes several SSU students. One of his hobbies is astrophotography.

As a freshman Tom is currently taking the first course in the calculus-based physics sequence. He is also learning BASIC computer programming, and he has entered 279 galaxies and nebulae from the NGC(New General Catalog) into a data file. Eventually he intends to pursue graduate study in -- what else? -- astronomy.

A lifelong resident of Sonoma, Tom commutes from home. His father, the late Alexander McMahon, was a judge in southern Sonoma County. Weekends find Tom working at Shone's Country Store in Glen Ellen. This leaves little time for another hobby -- scuba diving on the Sonoma coast. But the ocean will wait. Right now there are galaxies to explore.

Optical Levitation *continued*

Soon after the invention of the laser in 1960, researchers noticed that particles which happened to fall into the laser beam seemed not only to be accelerated along the beam, but to seek the center of the beam instead of the outside fringes. It was postulated that the particles were accelerated because of thermal perturbation, not photon pressure. But calculations by Ashkin and others showed that the magnitude of the observed acceleration was too great to be attributed only to thermal excitation of the particles. Moreover, it was known that a laser beam operates within a mathematically perfect intensity profile called a transverse mode. The most useful mode has a Gaussian energy distribution. Thus, the intensity of the light is greatest at the center of the beam and lessens at the edges. Why, then, did the particles seek that area of the beam with the greatest energy, rather than seeking the areas of least energy?

Ashkin demonstrated that it was radiation pressure, not simple thermal excitation, which accelerated particles along the beam. He even calculated that it is possible to accelerate small particles with up to one million times the force of gravity!

Using small, spherical, transparent, plastic particles made by the Dow Chemical Company, Ashkin accelerated particles from .1 micron to 100 microns in diameter. Moreover, with two opposing laser beams he was able to form an "optical bottle," holding different size particles in suspension and manipulating them about in a controlled manner.

Minute in budget, but long on ingenuity, Soreng and DeFreez had to run their experiments using only materials on hand. In August 1980 they found some Dow Corning 704 Diffusion Pump Oil. Using a small sprayer, they managed to form droplets about 40 microns in diameter. The low indices of refraction and low vapor pressure of the droplets made them ideal for optical levitation. The one big disadvantage of these droplets, they found, was a vapor temperature of 300 degrees Celsius. Thus, the droplets tended to heat up and vaporize in the beam. However, with laser outputs between 40 and 400 milliwatts, they managed to suspend particles for up to 45 minutes.

Possible applications of optical manipulation include the separation of particles in liquids, the optical levitation of particles in air, the high velocity acceleration of electrically neutral particles, the separation of isotopes, the analysis of atomic beams and microsurgery.

Other interesting possibilities also came from DeFreez and Soreng's work. Would it be possible, for instance, to study drop-to-drop or single drop interactions? In atmospheric studies, much is known about large-scale interactions, but very little about interactions on the particle-to-particle level. Because the laser can be focused to the theoretical limit of one wavelength, it may be possible to manipulate atomic and even subatomic sized particles. There exist, as well, facinating possibilities in the study of resonance phenomena.

Note: Keith Soreng will present an account of this experiment in the "What Physicists Do" series May 4.